



Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

A photograph of a man in a green jacket and sunglasses standing next to a concrete wall with wooden slats. The wall is part of a larger structure, possibly a bridge or a retaining wall, and is surrounded by lush green plants and flowers. In the background, there is a dense forest with trees showing autumn foliage.

2026
Abschlussarbeiten
Travaux de fin d'études
Graduation Theses

Master of Science in Engineering

- School of Architecture, Wood and Civil Engineering
- School of Engineering and Computer Science

Inhalt

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Prof. Andreas Habegger
Leiter Master of Science in Engineering
Responsable du domaine Master of Science in Engineering
Head of Division Master of Science in Engineering

Liebe Leserin, lieber Leser

Das MSE-Book bietet einen interessanten Einblick in die spannenden Projekte, die die Studierenden mit viel Engagement, Kreativität und Hingabe bearbeitet haben.

Der Master of Science in Engineering ist ein Kooperationsmaster aller acht Schweizerischen Fachhochschulen. An der BFH bilden wir spezialisierte Fachkräfte in elf Profilen aus. Die Student*innen, die dieses Programm absolvieren dürfen, zählen in der Schweiz zu den qualifiziertesten Talenten. Sie werden durch unsere Dozierenden und wissenschaftlichen Mitarbeitenden praxisnah, zukunftsgerichtet und mit vielfältigen Kompetenzen ausgestattet und auf die kommenden Herausforderungen in der Berufswelt vorbereitet.

Von grosser Bedeutung sind für uns die Kooperationen mit der Wirtschaft. Ich freue mich daher, dass es auch in diesem Jahr wieder möglich war, zahlreiche Master-Arbeiten gemeinsam mit Industriepartnern sowie Forschungseinrichtungen durchzuführen. Der Transfer von angewandter Forschung in die praktische Anwendung ist für uns zentral.

Viel Spass bei der Lektüre der diesjährigen Abschlussarbeiten!

Chère lectrice, cher lecteur,

Le Book du Master of Science in Engineering offre un tableau passionnant des projets sur lesquels nos étudiant-e-s ont travaillé avec beaucoup d'engagement, de créativité et de dévouement.

Le MSE est un programme d'études proposé conjointement par l'ensemble des huit hautes écoles spécialisées suisses. La BFH forme des spécialistes dans onze profils. Les étudiant-e-s habilité-e-s à suivre ce programme comptent parmi les talents les plus qualifiés de Suisse. Nos enseignant-e-s ainsi que nos collaborateurs et collaboratrices scientifiques leur transmettent une vaste palette de compétences axées sur la pratique et orientées vers l'avenir pour les préparer aux défis professionnels de demain.

La coopération avec les milieux économiques revêt une importance essentielle à nos yeux. Je suis donc très heureux qu'il ait été possible, cette année encore, de réaliser de nombreux travaux de master en collaboration avec des partenaires industriels et des instituts de recherche. Le transfert de la recherche appliquée vers l'application pratique nous tient tout particulièrement à cœur.

Je vous souhaite une agréable lecture des travaux de fin d'études 2026 !

Dear Reader

The MSE Book offers a valuable insight into the exciting projects undertaken by our students with no end of commitment, creativity and dedication.

The Master of Science in Engineering is a cooperative master's programme run by all eight Swiss universities of applied sciences. At BFH, we train specialised professionals in eleven profiles. Students selected for this programme are among the most qualified talents in Switzerland. Our lecturers and research associates provide them with the diverse industry-relevant, future-oriented skills required to prepare them for the challenges that lie ahead in the professional world.

Collaboration with industry is extremely important to us. So I am all the more pleased that this year it was once again possible to carry out numerous master's theses in conjunction with industrial partners and research institutions. The transfer of applied research into practical application is a key priority for us.

We hope you enjoy reading this year's graduation theses.

Master of Science in Engineering an der BFH

Le Master of Science in Engineering à la BFH

Master of Science in Engineering at BFH

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An der Berner Fachhochschule BFH wird anwendungsorientiert gelehrt und geforscht. Das Zusammenspiel von Lehre, Forschung und Entwicklung sowie Weiterbildung gewährleistet an den Departementen Architektur, Holz und Bau sowie Technik und Informatik Praxisnähe, innovative und zukunftsgerichtete Lösungen, gepaart mit unternehmerischem Spirit.

Der Master-Studiengang Master of Science in Engineering (MSE) ist ein gemeinsames Bildungsangebot aller Schweizer Fachhochschulen. Das MSE-Diplom ist der höchste akademische Abschluss, den die Fachhochschulen im Bereich Technik und Informatik, Life Sciences sowie Bauwesen vergeben. Das Studium steht nur den besten Abgänger*innen der Bachelor-Studiengänge offen. Entsprechend hoch ist auch die Anerkennung dieses Mastertitels, der seit 2008 mit grossem Erfolg angeboten wird.

Internationale Ausrichtung

Mit der zunehmenden Internationalisierung steigt die Vergleichbarkeit der Studiengänge. Der internationale Austausch ist ein wichtiger Aspekt dieser Master-Ausbildung: Einerseits sind Studienaufenthalte im Ausland möglich, andererseits bieten mehrere Vertiefungen (Profile) auch eine Mitarbeit in internationalen Forschungsprojekten an. Hinzu kommt, dass die Mehrzahl der zentralen, gesamtschweizerisch organisierten Lehrveranstaltungen in Englisch durchgeführt werden. Dies bringt den Student*innen nebst Kontakten mit Gleichgesinnten aus dem In- und Ausland auch sprachlich einen deutlichen Mehrwert.

Hoher Praxisbezug

Die theoretische Grundausbildung wird von den Schweizer Fachhochschulen gemeinsam an den zentralen Standorten in Lausanne, Zürich und Lugano angeboten. Dies ermöglicht unseren Studierenden,

L'enseignement et la recherche à la Haute école spécialisée bernoise BFH sont axés sur les applications. Au sein du département Architecture, bois et génie civil et du département Technique et informatique, l'interaction entre les cours, la recherche et le développement, et la formation continue garantit une proximité avec la pratique, des solutions innovantes et orientées vers l'avenir, le tout couplé à l'esprit d'entreprise.

Le programme de Master of Science in Engineering (MSE) est une offre de formation conjointe de l'ensemble des hautes écoles spécialisées suisses. C'est le diplôme le plus élevé décerné par les hautes écoles spécialisées dans les domaines Technique et informatique, Life Sciences et Génie civil. Seul-e-s les meilleur-e-s diplômé-e-s des filières d'études de bachelor y ont accès. La reconnaissance de ce titre de master, qui rencontre un franc succès depuis 2008, est d'autant plus élevée.

Orientation internationale

Avec l'internationalisation croissante, il est de plus en plus facile de comparer les filières d'études. L'échange international représente un aspect important de ce cursus de master: il est d'une part possible d'effectuer des séjours d'études à l'étranger, d'autre part plusieurs orientations (profils) proposent une coopération à des projets de recherche internationaux dans le cadre de l'orientation technique. En outre, la majorité des cours centraux se déroulent en anglais, ce qui permet aux étudiant-e-s d'entrer en contact avec des personnes de Suisse et de l'étranger partageant les mêmes idées et favorise la création d'un solide réseau professionnel international.

Forte orientation pratique

La formation théorique de base est proposée conjointement par les hautes écoles

Teaching and research activities at Bern University of Applied Sciences BFH are strongly practice-oriented. The interplay of teaching, research & development and continuing education – coupled with an entrepreneurial spirit – guarantees industry-driven, innovative and future-oriented solutions at the School of Architecture, Wood and Civil Engineering and the School of Engineering and Computer Science.

The Master of Science in Engineering (MSE) programme is run jointly by all Swiss universities of applied sciences. The MSE degree is the highest academic qualification they can award in engineering, information technology, life sciences and civil engineering. It is only open to the best graduates from the bachelor's degree programmes. The MSE was launched in 2008 and has since then enjoyed considerable success.

International orientation

Degree programmes have become easier to compare in the context of increasing internationalisation. Fittingly, international exchange is a key component of the MSE. Stays abroad are possible, and several specialisations (profiles) offer the opportunity to collaborate on international research projects. Furthermore, most courses organised centrally for students from across the country are conducted in English. Students can meet like-minded peers from Switzerland and abroad, which is an enabler for an international professional network.

High degree of practical application

The core modules are provided jointly by the Swiss universities of applied sciences at three locations: Lausanne, Zurich and Lugano. This allows our students to expand their national network and benefit from the key competencies of all Swiss universities of applied sciences. In parallel

4 ihr nationales Netzwerk zu erweitern und von den Schlüsselkompetenzen aller Schweizer Fachhochschulen zu profitieren. Parallel zum Besuch der Theoriemodule werden die Studierenden von Beginn an in eine Forschungseinheit eingebunden und arbeiten an Projekten aus der Praxis. Die Abschlussarbeiten sind alle direkt an Fragestellungen aus der Wirtschaft gekoppelt.

Gute Marktchancen

Studienabgänger*innen des Master of Science in Engineering sind in Start-ups sowie in Forschungs- und Entwicklungsabteilungen, Logistik, Unternehmensberatung und in öffentlichen Institutionen erfolgreich tätig. Sie tragen massgeblich dazu bei, wissenschaftliche Erkenntnisse in die Praxis zu überführen.

Darüber hinaus sind sie in Bereichen wie Umwelt, IT-Sicherheit, Bauwesen, Medizintechnik und Wirtschaftsingenieurwesen stark gefragt. Dank der häufig engen Zusammenarbeit mit Unternehmen im Rahmen ihrer Abschlussarbeit verfügen sie zudem über ausgezeichnete Voraussetzungen für einen erfolgreichen Berufseinstieg.

Das Weiterbildungsangebot richtet sich an Ingenieur*innen und angehende Forscher*innen, die ihre Kompetenzen erweitern oder ergänzen wollen. Nebst den Tätigkeiten in den Bereichen Lehre und Weiterbildung wird anwendungs- und marktorientierte Forschung betrieben, um den Wissenstransfer in die Wirtschaft und die Nähe zur Industrie zu gewährleisten.

Erfahren Sie mehr über

- › den Master of Science in Engineering: bfh.ch/mse
- › das Departement Technik und Informatik: bfh.ch/ti
- › das Departement Architektur, Holz und Bau: bfh.ch/ahb
- › Weiterbildungsangebote am Departement Technik und Informatik: bfh.ch/ti/weiterbildung
- › Weiterbildungsangebote am Departement Architektur, Holz und Bau: bfh.ch/ahb/de/weiterbildung

spécialisées suisses sur les sites centraux à Lausanne, Zurich et Lugano. Cela permet à nos étudiant-e-s d'élargir leur réseau national et de profiter des compétences clés de l'ensemble des hautes écoles spécialisées suisses. Parallèlement au suivi des modules théoriques, les étudiant-e-s sont intégré-e-s dès le début à une unité de recherche et travaillent sur des projets concrets. Les travaux de fin d'études sont tous liés directement aux défis du monde économique.

Opportunités sur le marché

Les diplômé-e-s du Master of Science in Engineering excellent au sein de startups et dans des unités de recherche et de développement, la logistique, le conseil en entreprises ou dans des institutions publiques, contribuant à transposer des connaissances de pointe dans la pratique. Ils et elles sont également très recherché-e-s dans des secteurs tels que l'environnement, la sécurité IT, la construction, l'ingénierie médicale ou encore l'ingénierie commerciale. Ayant souvent déjà collaboré étroitement avec une entreprise dans le cadre de leur travail de fin d'études, ils et elles ont d'excellentes perspectives de s'insérer dans le monde économique.

L'offre de formation continue s'adresse aux ingénieur-e-s et aux futur-e-s chercheurs et chercheuses qui souhaitent étendre ou enrichir leurs compétences. Outre les activités dans les domaines de la formation et de la formation continue, ce domaine de spécialité propose des activités de recherche axées sur le marché et la pratique, garantissant ainsi le transfert des connaissances dans le monde de l'économie et la proximité avec l'industrie.

En savoir plus

- › Master of Science in Engineering: bfh.ch/fr/mse
- › Département Technique et informatique: bfh.ch/ti/fr
- › Département Architecture, bois et génie civil: bfh.ch/ahb/fr
- › Offre de formation continue du département Technique et informatique: bfh.ch/ti/formationcontinue
- › Offre de formation continue du département Architecture, bois et génie civil: bfh.ch/ahb/formationcontinue

with the theory modules, students are involved from the outset in a research unit and work on applied research projects. The graduation theses all address industry-related issues.

Good market opportunities

Graduates of the Master of Science in Engineering excel in startups, multinational corporations, research & development, business consulting and public institutions, bringing cutting-edge knowledge into practice. They are highly sought after in sectors such as environment, IT security, medical engineering, construction, and business engineering. As they have often already collaborated with a company as part of their graduation thesis, their prospects of gaining a foothold in industry are excellent.

The continuing education programme is aimed at engineers and prospective researchers who wish to extend or enhance their skills. In addition to teaching and continuing education, application-led and market-oriented research activities ensure an efficient knowledge transfer and close ties to industry.

Find out more

- › Master of Science in Engineering: bfh.ch/en/mse
- › School of Engineering and Computer Science: bfh.ch/ti/en
- › School of Architecture, Wood and Civil Engineering: bfh.ch/ahb/en
- › Continuing education at the School of Engineering and Computer Science: bfh.ch/ti/continuingeducation
- › Continuing education at the School of Architecture, Wood and Civil Engineering: bfh.ch/ahb/continuingeducation

Steckbrief

Fiche signalétique

Fact Sheet

5

Titel/Abschluss

Master of Science (MSc) in Engineering

Studienform

Vollzeitstudium (3 Semester) oder Teilzeitstudium (7 Semester)

Unterrichtssprache

Englisch, Deutsch und Französisch

Vertiefungen

Der Master of Science in Engineering (MSE) umfasst eine breite Palette an fachlichen Spezialisierungen. Diese sind schweizweit in sechzehn Profile gegliedert. An der Berner Fachhochschule können Studierende aus elf dieser Profile wählen, um ihre Expertise in einem gewünschten Fachgebiet weiterzuentwickeln:

- Business Engineering
- Civil Engineering
- Computer Science
- Data Science
- Electrical Engineering
- Energy and Environment
- Information and Cyber Security
- Mechanical Engineering
- Mechatronics and Automation
- Medical Engineering
- Photonics and Laser Engineering

Das gewählte Profil ermöglicht eine beinahe massgeschneiderte fachliche Vertiefung, welche an einer unserer Forschungseinrichtungen in enger Zusammenarbeit mit einem Advisor absolviert wird.

Abschlussarbeit

Die praxisorientierte Ausrichtung des Studiengangs steht im Mittelpunkt: Studierende werden aktiv in Forschungsprojekte eingebunden und verfassen ihre Abschlussarbeit – im Vollzeitstudium in einem, im Teilzeitstudium in zwei Semestern – in der Regel in enger Zusammenarbeit mit einem Unternehmen.

Kontakt

Haben Sie Fragen zum Master-Studiengang MSE? Wir freuen uns auf Ihre Kontaktaufnahme!

mse@bfh.ch (Sekretariat)

Web

bfh.ch/mse
bfh.ch/book-mse
bfh.ch/registration-mse

Titre/Diplôme

Master of Science (MSc) in Engineering

Forme des études

Études à plein temps (3 semestres) ou à temps partiel (7 semestres)

Langues d'enseignement

Anglais, allemand et français

Orientations

Le Master of Science in Engineering (MSE) englobe une large palette d'orientations techniques réparties sur seize profils. À la Haute école spécialisée bernoise, les étudiant-e-s peuvent choisir parmi onze profils afin de développer leur expertise dans le domaine de leur choix:

- Business Engineering
- Civil Engineering
- Computer Science
- Data Science
- Electrical Engineering
- Energy and Environment
- Information and Cyber Security
- Mechanical Engineering
- Mechatronics and Automation
- Medical Engineering
- Photonics and Laser Engineering

Le profil choisi offre un approfondissement presque sur mesure des connaissances techniques dans l'une de nos unités de recherche, en étroite collaboration avec un-e mentor-e.

Travail de fin d'études

L'orientation pratique du programme d'études nous tient à cœur: les étudiant-e-s sont impliqué-e-s activement dans des projets de recherche et réalisent généralement leur travail de fin d'études en collaboration étroite avec une entreprise – sur un semestre pour les étudiant-e-s à plein temps, sur deux semestres pour les étudiant-e-s à temps partiel.

Contact

Avez-vous des questions sur la filière d'études de master MSE? N'hésitez pas à nous contacter!

mse@bfh.ch (Secrétariat)

Internet

bfh.ch/fr/mse
bfh.ch/book-mse
bfh.ch/registration-mse

Title/degree

Master of Science (MSc) in Engineering

Mode of study

Full-time (3 semesters) or part-time (7 semesters)

Language of instruction

English, German and French

Specialisations

The Master of Science in Engineering (MSE) offers a wide range of engineering specialisations divided into 16 profiles in Switzerland. Bern University of Applied Sciences offers eleven profiles, providing students with the opportunity to further develop their expertise in their chosen subject area:

- Business Engineering
- Civil Engineering
- Computer Science
- Data Science
- Electrical Engineering
- Energy and Environment
- Information and Cyber Security
- Mechanical Engineering
- Mechatronics and Automation
- Medical Engineering
- Photonics and Laser Engineering

The chosen profile enables students to complete a virtually bespoke specialisation under the close supervision of an advisor at one of our research institutions.

Graduation thesis

Practical relevance lies at the heart of the degree programme: students are actively involved in research projects and write their graduation thesis, usually in close cooperation with a company, in one semester on the full-time programme and two semesters on the part-time programme.

Contact

Do you have any questions about the MSE master's degree programme? We look forward to hearing from you.

mse@bfh.ch (faculty office)

Website

bfh.ch/en/mse
bfh.ch/book-mse
bfh.ch/registration-mse

Interviews mit Studierenden

Interviews d'étudiant-e-s

Interviews with students

6



Marco Eggimann

Warum haben Sie sich für dieses Studium entschieden?

Nach dem Bachelor wollte ich mich gezielt und vertieft mit dem Bereich Tragwerke auseinandersetzen. Das Bachelorstudium in Burgdorf ist bewusst breit angelegt, was ich rückblickend als gute Grundlage sehe. Besonders der konstruktive Ingenieurbau hat mich während des BSc-Studiums interessiert. Mit dem Master wollte ich mir die fachliche Tiefe in diesem Bereich erarbeiten, um komplexere Tragwerke eigenständig planen und beurteilen zu können.

Was gefiel Ihnen besonders gut an diesem Studium?

Besonders geschätzt habe ich die Seminare. Diese waren durchgehend praxisnah

aufgebaut und lebten vom aktiven Austausch und der Partizipation der Studierenden. Da viele bereits Berufserfahrung aus unterschiedlichen Bereichen mitbrachten, waren nicht nur die Inhalte der Veranstaltungen lehrreich, sondern auch die Diskussionen in den Pausen. Man konnte Erfahrungen teilen, voneinander profitieren und sich fachlich austauschen. Auch die technisch-wissenschaftlichen Wahlpflichtmodule habe ich sehr gerne besucht, da sie fachliche Inhalte für den konstruktiven Ingenieurbau gut vermittelten.

Wie sah der Studienalltag aus?

Der Studienalltag war vom selbstständigen Erarbeiten des Stoffes sowie vom eigenverantwortlichen Arbeiten an den Vertiefungsarbeiten geprägt. Die von mir

besuchten Module wurden als passivstreaming-Modul angeboten, wodurch man flexibel entscheiden konnte, ob man vor Ort oder online teilnimmt. Diese Flexibilität war ein grosser Vorteil und hat mir erlaubt, Reisezeiten deutlich zu reduzieren und Studium sowie Beruf effizient zu kombinieren.

Arbeiteten Sie nebenher? (während des Semesters oder während der Ferien)

Während des Studiums war ich zu 70 Prozent als Bauingenieur im Hochbau tätig. Herausfordernd war dabei, dass man im Ingenieurberuf früh eigene Projekte übernimmt und damit Verantwortung trägt. Der Anstellungsgrad ist eine Abmachung zwischen Arbeitgeber und Ingenieur und steht nicht immer im direkten Zusammen-

hang mit den Anforderungen einzelner Projekte. Entsprechend war es anspruchsvoll, die laufenden Projekte im Büro sowie die Abgabetermine aus Studium und Beruf miteinander zu koordinieren.

Was waren die grössten Herausforderungen im Studium?

Die grösste Herausforderung war für mich die hohe Flexibilität des Studienmodells. Da alle Studierenden unterschiedliche Module belegen und das Studium in unterschiedlichem Tempo absolvieren, entsteht nicht automatisch ein starkes Klassengefühl wie im Bachelor. Umso mehr habe ich die Seminare geschätzt, bei denen die Inhalte bewusst vor Ort und im direkten Austausch erarbeitet wurden.

Was möchten Sie nach dem Studium machen und was machen Sie heute beruflich?

Ich arbeite weiterhin als Bauingenieur und freue mich, nach Abschluss des Studiums nun Vollzeit tätig zu sein.

Inwiefern können Sie von Ihrem Studium profitieren?

Ich konnte im Studium komplexe Fragestellungen aus dem Berufsalltag vertieft anschauen und im akademischen Kontext unter weniger Zeitdruck bearbeiten. Gleichzeitig habe ich vieles des im Studium Erlernten direkt im Büro angewendet. Der konstruktive Ingenieurbau ist ein sehr umfangreicher und anspruchsvoller Bereich, in dem man nie ausgelernt hat. Das Masterstudium im Teilzeitmodell hat mir einen fließenden Übergang vom Vollzeitstudenten zum Vollzeitingenieur ermöglicht. Da ich ursprünglich eine handwerkliche Lehre als Zimmermann absolviert habe und zuvor nicht im Ingenieurbüro tätig war, hat mir dieses Modell geholfen, mich fachlich und organisatorisch sicher im Berufsalltag zu etablieren.

Welchen Tipp haben Sie für jemanden, der dieses Studium in Betracht zieht?

Ich empfehle trotz Herausforderungen

klar das Teilzeitmodell. Wer das Studium vollzeitlich absolviert, sollte bereits gut in ein bestehendes Umfeld in der jeweiligen Fachhochschule eingebunden sein. Andernfalls kann das Studium schnell als einsam empfunden werden, da sehr viel eigenständiges Arbeiten gefordert ist. Im Teilzeitmodell profitiert man deutlich vom direkten Bezug zur Praxis und vom ständigen Wechsel zwischen Theorie und Berufsalltag.



Interviews mit Studierenden

Interviews d'étudiant-e-s

Interviews with students

8



Coralie Rohrer

Pourquoi avez-vous choisi cette filière d'études ?

Titulaire d'un Bachelor en informatique avec une spécialisation en IT-Security et engagée professionnellement au sein du groupe de recherche Applied Machine Intelligence (AMI) de la BFH, j'ai souhaité approfondir et élargir mes compétences en data science. Le Master of Engineering en Data Science s'inscrivait ainsi naturellement dans la continuité de mon parcours académique et professionnel. La possibilité de suivre cette formation à temps partiel tout en poursuivant mon activité de recherche a également constitué un élément déterminant dans mon choix.

Qu'est-ce qui vous a le plus plu / a passionné tout particulièrement ?

J'ai particulièrement apprécié la diversité de l'offre de cours en data science, qui per-

mettait de personnaliser le cursus en fonction de ses intérêts. Les modules contextuels ont également été très enrichissants, notamment ceux liés à l'entrepreneuriat. Toutefois, ce sont surtout les projets de recherche, parfois menés avec des partenaires externes, qui m'ont le plus passionnée, car ils m'ont permis de mettre en pratique les connaissances acquises durant les cours.

Comment était votre emploi du temps pendant vos études ?

Mon emploi du temps combinait un travail à temps partiel au sein du groupe Applied Machine Intelligence à la BFH et les cours du master. Ces derniers étaient principalement regroupés sur deux journées complètes par semaine durant les trois premiers semestres, avec ponctuellement des journées

supplémentaires pour des modules complémentaires. Lors du dernier semestre, je n'avais plus de cours et me consacrais entièrement au développement et à l'implémentation de mon projet de thèse de master.

Avez-vous travaillé en parallèle ? (Pendant le semestre / pendant les vacances)

Oui, j'ai travaillé en parallèle de mes études durant toute la durée du master en tant qu'assistante au sein du groupe de recherche Applied Machine Intelligence. Mon activité associait étroitement la recherche et le soutien à l'enseignement, deux domaines qui m'ont passionnée avec la même intensité. La recherche appliquée, souvent menée avec des partenaires industriels, m'a permis de développer de solides compétences

techniques et en gestion de projet, tandis que l'implication dans l'enseignement a renforcé mes compétences pédagogiques et organisationnelles.

Quels étaient les principaux défis à affronter pendant les études ?

Durant les premiers semestres, la charge importante de modules théoriques nécessitait une planification rigoureuse afin de concilier le travail à temps partiel, les cours et le temps d'apprentissage, notamment pour la préparation aux examens. Lors des derniers semestres, l'un des principaux défis a été de répartir efficacement le temps entre l'activité professionnelle et le mémoire de master. Grâce à une organisation adaptée et à une certaine flexibilité, ces défis ont pu être relevés avec succès.

Quels sont vos projets d'avenir ? Que souhaitez-vous faire après vos études et que faites-vous aujourd'hui sur le plan professionnel ?

Je travaille actuellement à temps plein au sein du groupe de recherche

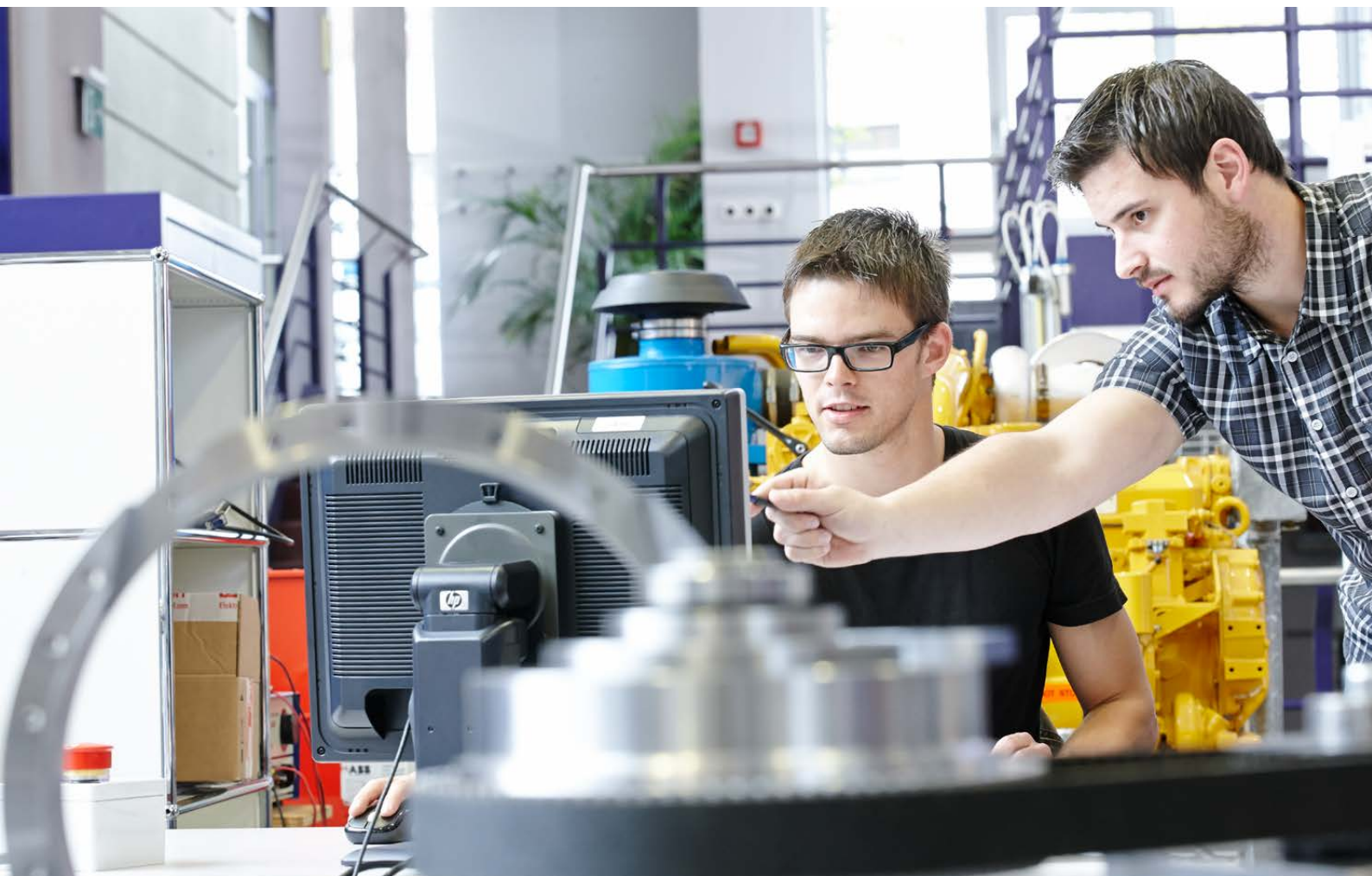
Applied Machine Intelligence (AMI), où je poursuis des activités de recherche appliquée. Mon rôle inclut également une implication croissante dans l'enseignement au sein de la filière de Bachelor en Data Engineering. Par ailleurs, j'explore actuellement différentes possibilités de financement afin de poursuivre le développement du prototype réalisé dans le cadre de mon mémoire de master, avec l'objectif de le faire évoluer vers un projet de recherche ou d'innovation appliquée.

Dans quelle mesure pouvez-vous tirer profit de vos études ?

Les connaissances théoriques et pratiques acquises durant mes études me sont déjà directement utiles dans mon activité professionnelle actuelle, où elles constituent des bases solides pour la recherche appliquée et les projets industriels. Par ailleurs, le master me permet d'être bien préparée aux exigences de l'industrie et ouvre, sur le plan académique, de nouvelles perspectives de développement.

Que diriez-vous à quelqu'un qui aurait envie d'entreprendre ce genre d'études ?

Je lui conseillerais de tirer pleinement parti de la flexibilité qu'offre le programme, tant dans le choix des modules que dans la durée des études. Je recommanderais également, lorsque cela est possible, de suivre la formation à temps partiel en parallèle d'une activité professionnelle. Cette combinaison favorise un apprentissage plus approfondi et permet de mettre directement en pratique les concepts théoriques abordés dans les modules.



Zusammenarbeitsformen

Formes de collaboration

Collaboration

10 Neue Erkenntnisse gewinnen, Synergien schaffen, Praxisnähe erfahren: Die Berner Fachhochschule arbeitet in der angewandten Forschung und Entwicklung eng mit der Wirtschaft und der Industrie zusammen. Dadurch wird die Verknüpfung von Forschung und Lehre gestärkt und es fließt neues Wissen in den Unterricht ein. Dies führt zu einer qualitativ hochwertigen und praxisnahen Lehre. Damit Unternehmen bereits heute die Spezialistinnen und Spezialisten von morgen kennenlernen oder sich an eine Thematik herantasten können, besteht die Möglichkeit, Projekt- oder Abschlussarbeiten in Zusammenarbeit mit Studierenden durchzuführen. Als Wirtschaftspartner können Sie Themen vorschlagen. Werden Themen gewählt, bearbeiten Studierende diese alleine oder in kleinen Gruppen in dafür vorgesehenen Zeitfenstern selbstständig. Dabei werden die Studierenden von ihrer Fachperson sowie einer Dozentin oder einem Dozenten der Berner Fachhochschule betreut. Die Rechte und Pflichten der beteiligten Parteien werden in einer Vereinbarung geregelt.

Möchten Sie Themen für studentische Arbeiten vorschlagen und mehr über eine mögliche Zusammenarbeit erfahren? Kontaktieren Sie uns und überzeugen Sie sich vom Innovationspotenzial unserer Studierenden.

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Acquérir de nouvelles connaissances, créer des synergies, découvrir la pertinence pratique : dans le domaine de la recherche appliquée et du développement, la Haute école spécialisée bernoise travaille en étroite collaboration avec l'économie et l'industrie. Le lien entre la recherche et la formation est ainsi renforcé et l'enseignement profite des nouvelles connaissances. Il en résulte une formation de grande qualité, axée sur la pratique. Pour que les entreprises puissent faire aujourd'hui déjà la connaissance des spécialistes de demain ou aborder un sujet particulier, elles ont la possibilité de réaliser des projets ou des travaux de fin d'études en collaboration avec des étudiant-e-s. En tant que partenaire économique, vous pouvez proposer des thèmes. S'ils sont choisis, les étudiant-e-s les traitent ensuite de manière autonome, seul-e-s ou en petits groupes, dans les créneaux horaires prévus à cet effet. Ils et elles sont encadré-e-s par votre spécialiste ainsi que par un-e enseignant-e de la Haute école spécialisée bernoise. Une convention régit les droits et obligations des parties au projet.

Souhaitez-vous proposer des thèmes pour des travaux d'étudiant-e-s et en savoir plus sur une éventuelle collaboration ? Contactez-nous et laissez-vous convaincre par le potentiel d'innovation de nos étudiant-e-s.

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Gain new insights, create synergies, experience practical relevance: Bern University of Applied Sciences BFH works closely with business and industry in areas of applied research and development. This strengthens the link between research and education, allowing new knowledge to flow into our teaching, which leads to high-quality and practice-oriented degree programmes. In order for companies to meet our future specialists or to explore a topic, they can carry out projects or theses in cooperation with our students. As a business partner, you can suggest topics. Once these topics are selected, the students work on the projects independently, either individually or in small groups, within designated time frames. They are supervised by both your specialist and a BFH lecturer. The rights and obligations of the parties involved are set out in a written agreement.

Would you like to suggest topics for student projects and find out more about a possible cooperation? Contact us and convince yourself of the innovation potential of our students.

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Studentische Arbeiten | Travaux d'étudiant-e-s | Student projects

Das Modell einer flexiblen Zusammenarbeit mit Industrie und Wirtschaft wird in studentischen Arbeiten erfolgreich umgesetzt:
La flexibilité du modèle de collaboration avec l'industrie et l'économie se concrétise avec succès dans les travaux d'étudiant-e-s:
The model of flexible cooperation with industry and business is successfully implemented in student projects:



Semesterarbeiten, Bachelor-Thesis, Master-Thesis
Travaux de semestre, travail de bachelor, mémoire de master
Semester projects, bachelor thesis, master thesis



Wochen bis Monate
De quelques semaines à plusieurs mois
Several weeks or months



Kostenbeitrag zulasten des Auftraggebers
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Wir bieten Auftragsforschung und erbringen vielfältige Dienstleistungen für unsere Kundinnen und Kunden (inkl. Nutzung der BFH-Infrastruktur sowie des Forschungsnetzwerkes). | Nous effectuons des recherches sous contrat et fournissons une vaste palette de prestations de services à nos clientes et clients – y compris l'utilisation des infrastructures BFH et du réseau de recherche. | We carry out contract research and provide a wide range of services for our clients, such as exclusive use of the BFH infrastructure and the research network.



Planung, Coaching, Tests, Expertisen, Analysen;
durchgeführt von Expertinnen und Experten
Planification, coaching, tests, expertises, analyses par des expert-e-s
Planning, coaching, tests, expertise, analysis: done by experts



Wochen bis Monate
De quelques semaines à plusieurs mois
Several weeks or months



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F&E-Kooperationen | Coopérations R&D | R & D Collaboration

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Monate bis Jahre
De quelques mois à plusieurs années
Several months or years



Teilfinanziert durch
öffentliche Fördergelder
Financement partiel par
des subventions publiques
Partly public funding

Industriepartner

Partenaires industriels

Industry partners

- 12 Eine enge Zusammenarbeit mit Industriepartnern ist uns äusserst wichtig. Zahlreiche Abschlussarbeiten sind in Kooperation mit Firmen aus der ganzen Schweiz entstanden. Wir bedanken uns bei diesen Firmen für die fruchtbare Zusammenarbeit!

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À nos yeux, une collaboration étroite avec des partenaires industriels est extrêmement importante. De nombreux mémoires se font en partenariat avec des entreprises de toute la Suisse. Nous remercions ces entreprises pour cette fructueuse collaboration!

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A close cooperation with industrial partners is very important to us. Numerous theses have been produced in cooperation with companies from Switzerland. We thank these companies for the fruitful collaboration!

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Bern Racing Team, Biel
Berner Fachhochschule - SCI-Mobility-Lab, Biel/Bienne
BSL Baustofflabor AG, Uetendorf
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Liste der Studierenden

Liste des étudiant-e-s

List of students

- 14
Im Folgenden präsentieren wir Ihnen die Zusammenfassungen der Abschlussarbeiten des Jahres 2026.

Die Studierenden sind in alphabetischer Reihenfolge aufgeführt.

Die Studierenden haben die Texte – teils mit Unterstützung der betreuenden Dozierenden – selbst verfasst. Die Texte wurden vor Publikation nicht systematisch redigiert und korrigiert.
- Ci-après, nous vous présentons les résumés des travaux de fin d'études de l'année 2026.

Les étudiant-e-s sont présenté-e-s par ordre alphabétique.

Ils et elles ont rédigé les textes de façon autonome, parfois avec l'aide des enseignant-e-s qui les encadrent. Les textes n'ont pas systématiquement été relus ou corrigés avant publication.
- On the next pages, we have summarised the 2026 graduation theses.

The students are listed in alphabetical order.

The texts were written by the students themselves, with some support from their lecturers. They were not systematically edited or corrected before publication.

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Uncertainty Management of Wood Composite Structures Properties

Degree programme : Master of Science in Engineering
Specialisation : Mechanical Engineering
Thesis advisor : Prof. Roland Rombach
Expert : Prof. Dr. André Lisibach

15

Wood composites are made from compressed wood fibers, particles or strands and offer a promising route for resource-efficient wood-based products. This thesis develops a numerical workflow to extract representative volume elements from pressed wood elements, homogenize their elastic properties and evaluate the resulting variability and modelling uncertainty.

Background and aim

The effective stiffness of wood-based composites depends on geometry and orientation of the wood elements, board density, local compaction, contacts and the orthotropic behaviour of spruce. Since these factors vary within a pressed board, a single deterministic property value is not sufficient. The aim was to develop a numerical workflow for estimating homogenized elastic properties from multiple representative volume elements (RVEs).

Method

A parametrically generated strand assembly was pressed numerically in LS-DYNA. The deformed mesh and true volumetric strain field were transferred to a Static Structural environment, where cubic RVEs were extracted from the compacted board. Each RVE was imported through External Model into Ansys Mechanical and reconstructed automatically with bonded contacts, local density-based material properties, strand-aligned spruce orientations and six kinematic uniform boundary condition load cases. The stiffness matrices were converted into effective elastic constants.

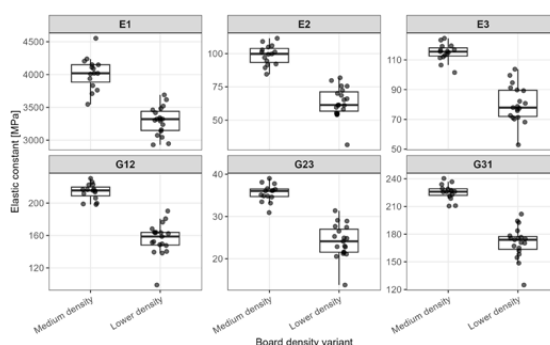
Results and contribution

The workflow enabled quality-controlled post-processing of homogenized RVE properties. The RVE-size study showed the compromise between local averaging and statistical sampling: larger RVEs reduced local variability, while smaller RVEs provided

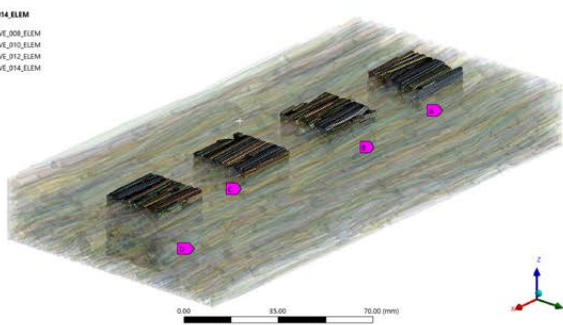
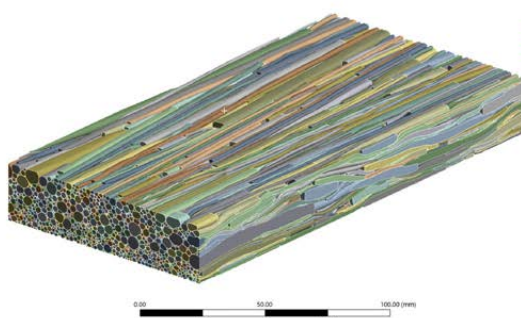
more accepted samples. Sensitivity studies confirmed that strand-aligned material orientation is essential and showed that pressing-induced compaction can be transferred to the RVE model at strand level and linked to changes in effective stiffness. Production-related comparisons provided first numerical trends for strand length, board density and strand-orientation distribution. Shorter strands reduced homogenized stiffness, lower target density decreased all elastic constants, and less aligned strands reduced longitudinal stiffness and anisotropy while moderately increasing selected transverse and shear-related responses. The main contribution is a traceable framework connecting board generation, pressing-induced compaction, RVE extraction, finite-element homogenization and uncertainty evaluation for wood-based composites.



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Elastic constants by board density variant. Values have been scaled by an undisclosed constant factor.



Deformed mesh board from pressing simulation in LS-DYNA and RVEs extraction for homogenization simulations in Ansys Mechanical.

Early Detection of Lithium Plating in Fast Charging Protocols for NMC Cells

Degree programme: Master of Science in Engineering

Specialisation: Mechatronics and Automation

Thesis advisor: Prof. Dr. Priscilla Caliandro

Expert: Dr. Jackub Włodarczyk (ABB)

16

Fast charging of lithium-ion batteries is a key enabler for the widespread adoption of electric vehicles (EVs) and other high-power applications. The thesis aims to investigate the degradation mechanism known as lithium plating, which undermines not only safety but also the remaining capacity of lithium-ion cells. Through a range of fast-charging tests and validation via cell teardown, a physics-based model (PBM) is adjusted to match the studied degradation phenomenon.



Yohan Aymon

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Introduction

Nowadays, fast charging is a common feature implemented in many devices. These charging strategies can lead to strong degradation phenomena and notably lithium plating: an accumulation of non-intercalated lithium at the anode interface when the anode potential drops below 0 V vs Li/Li⁺. Detecting and mitigating lithium plating during fast charging is therefore crucial to improving charge acceptance while ensuring long-term reliability. In this context, the BFH leads the project Accelerated Aging ProTocol for battEry Systems (Adaptes), aiming at reducing the duration of degradation tests and bridging the discrepancies between laboratory degradation and real-world usage.

Dataset generation

Eleven different fast-charging scenarios were designed to induce varying degrees of lithium plating on commercial LG Chem 21700 M50LT lithium-ion cells. Under the three main plating-prone conditions (low temperatures, high C-rates (current/battery capacity), and high state of charge (SOC)), the cells were cycled in a temperature-controlled chamber using a battery cycler and periodically characterized with electrochemical impedance spectroscopy (EIS), incremental capacity analysis (ICA), and differential voltage analysis (DVA). Through OCV fitting and analysis of DVA and ICA [fig. left], the computation of the degradation modes was realized. The distribution

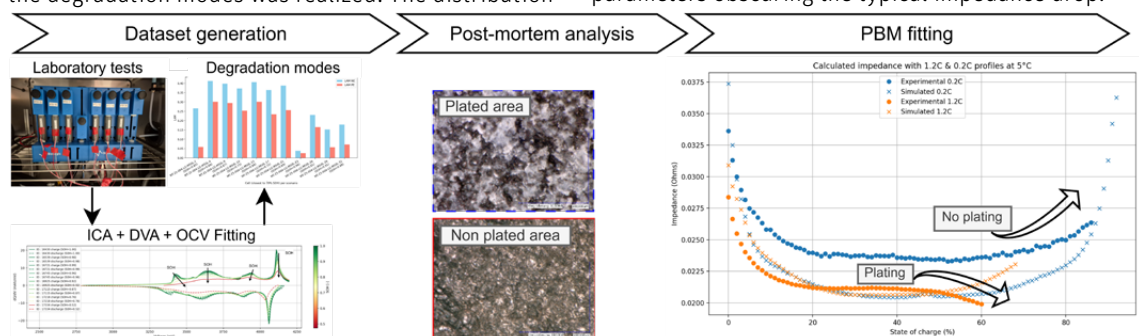
of relaxation times (DRT) was explored to identify lithium-plating-related signatures notably affecting the solid electrolyte interphase (SEI).

Post-mortem analysis

Different post-mortem analysis strategies were conducted to validate the presence of lithium plating. Optical microscopy observations [fig. middle] and scanning electron microscopy (SEM) imaging and Energy Dispersive Spectroscopy (EDS) mapping were initially utilized and could only reveal strong occurrences of plating. To overcome this flaw and comparatively quantify plating, a second approach with a portable glovebox in combination with XPS measurement techniques was performed to confirm the presence of lithium plating at the anode surface.

Physics-based model (PBM)

Finally, a PBM incorporating lithium plating mechanisms was adjusted to the experimental data using two different fitting approaches, first with time-series data and then with EIS. The objective of the model was to precisely indicate plating occurrences during fast charging. The EIS fitting strategy showed good agreement with the experimental results [fig. right]; however, at medium C-rates, even under stripping current, the model lacked the characteristic impedance drop indicative of plating occurrences. Further investigation should be carried out to identify the parameters obscuring the typical impedance drop.



Left : Aging tests | mid : post-mortem analysis microscope images | Right : Test of characteristic impedance drop (orange) of plating generation.

Closed loop system for supporting the rehabilitation process in spinal cord injury patients

Degree programme : Master of Science in Engineering

Specialisation : Medical Engineering

Thesis advisor : Prof. Dr. Kerstin Denecke

Expert : Stefan Stalder (Schweizer Paraplegiker-Zentrum)

Industrial partner : Berner Fachhochschule - SCI-Mobility-Lab, Biel/Bienne

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Spinal cord injury patients may train on the GO-TRYKE, a tricycle with coupled arm and leg pedals that records biomechanical data on every ride. This thesis turns that data into a closed-loop software: machine learning predicts how the next session will develop, while clinically confirmed indicators and rule-based recommendations give therapists objective, session-to-session feedback instead of relying on experience and trial-and-error alone.

Problem

About 15 million people worldwide live with a spinal cord injury, and many lose muscle mass once they can no longer move their legs. The GO-TRYKE, a tricycle with coupled arm and leg pedals, is used in their rehabilitation and records biomechanical data on every ride. Still, therapists adjust training mostly by experience and trial and error, with little objective feedback on a patient's progress between sessions. A clinical interview confirmed that no standard set of progress indicators for this kind of training exists yet.

Method

A system was built from raw sensor data to working software. A study covering healthy, incomplete and complete paraplegia produced over 500,000 measurements, augmented to 216 sessions for training. Three progress indicators were derived, including a self-developed Lower Limb Force Index (LLFI) and five machine learning models were then compared against two baselines and tested on new data.

Results

Support Vector Regression was chosen as the final model, and predictions reached the point that some parameters clearly beat the baseline methods. A mechanism that adapts predictions to the individual patient lowered the error by about 3% after nine sessions. The result is an application where a patient uploads a session and sees a dashboard with progress, a predicted next session, prediction feedback and a recommendation for next training. Experts rated the usability at around 76% on the Healthcare System Usability Scale (HSUS) and said they would use the predictions alongside their own clinical judgement.

Conclusion

This work shows that session-to-session rehabilitation progress can be predicted from biomechanical data, and it delivers clinically confirmed indicators and a working prediction system. Above all, it lays the foundation for a platform that merges data from several devices, so therapists could one day follow a patient's whole rehabilitation, not just one machine.



Jan Gabriel Bauer

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Full dashboard view with the prediction feature activated. A dotted orange line after the last session indicates the model's prediction. Recommendations and feedback are visualized in the right panel.

Plasma Electrolytic Polishing of Brass Watch Components

Degree programme: Master of Science in Engineering
Specialisation: Mechanical Engineering
Thesis advisor: Prof. Dr. Cédric Bessire
Expert: Dr. Julien Zimmermann (Endress+Hauser Group)
Industrial partner: Christopher Ward SA, Biel

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Surface finishing processes such as polishing are key manufacturing steps in various industries, shaping the quality of a product and significantly increasing its value. In the watch industry, polishing processes involve many manual working steps limiting automation and scalability. This thesis examines whether plasma electrolytic polishing (PEP) has the potential to replace conventional polishing processes.



Jan Bloch
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Introduction

Plasma electrolytic polishing is an innovative polishing technique that smoothes the surface of metals through plasma-electrochemical effects. Unlike the related process of electropolishing, PEP uses an environmentally friendly, water-based electrolyte without the need of precleaning steps. This thesis focuses on the identification of a suitable electrolyte for treating brass pieces for the watch industry.

Methods

Based on a literature review, electrolytes with varying chemical compositions were investigated to identify compatible mixtures for brass treatment. Key process parameters like conductivity and pH were determined by the electrolyte composition, while the process temperature was held constant above 80 °C. Voltage and polishing time were defined as independent variables and were systematically varied. The response variable was the surface roughness value Ra measured after PEP treatment. All experiments were planned and evaluated using a structured Design of Experiments (DOE) approach.

Results

After the initial test phase, two electrolytes proved to be compatible for brass. The first was based on citric acid (CA), the second on acetic acid (AA). For both electrolytes, the conductivity at process temperature was within 110-120 mS/cm and the pH value around 4.5-5.5. The DOE analysis shows that for both electrolytes, the optimum voltage is rather at the lower end of the PEP technology below 300V. A brief 30sec PEP process in an electrolyte bath reduced the initial surface roughness of the brass sample from Ra = 500nm to Ra < 200 nm. In addition, an improved gloss effect can be observed on the real watch workpieces as can be seen in Figure 1. While both electrolytes enabled stable and reproducible processing, the CA electrolyte demonstrated superior performance, achieving higher surface gloss, surface uniformity without visible microstructures and fewer side effects. Overall, PEP represents a promising polishing process for small brass watch components.

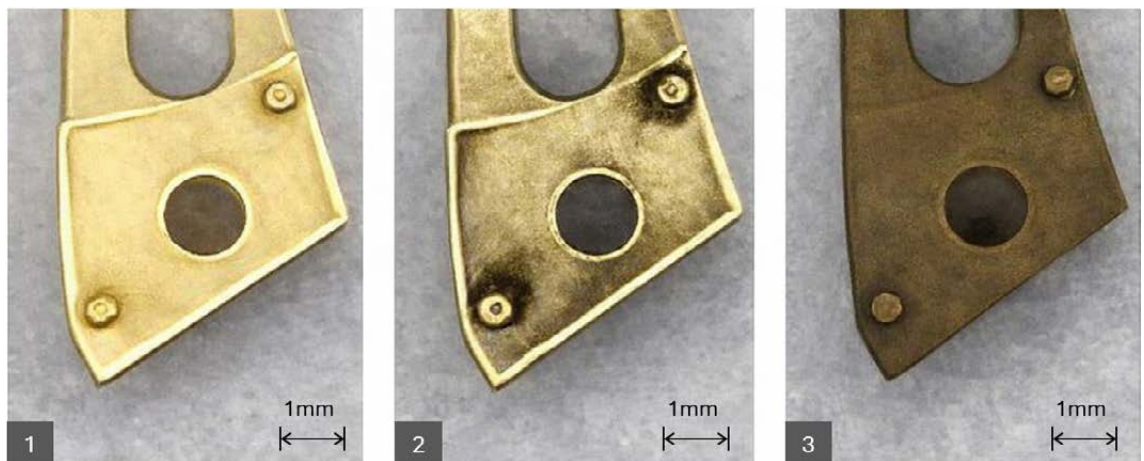


Figure 1: Comparison of Watch Components after PEP. CA-treated Component (1), AA-treated Component (2), untreated Component (3).

Robotic Automation on Farm Machines

Degree programme : Master of Science in Engineering
Specialisation : Computer Science
Thesis advisor : Prof. Marcel Pfahrer
Experts : Prof. Dr. Raphael Rätz, Prof. Dr. Francesco Carrino



Future agriculture requires more time- and cost-efficient solutions to meet the growing demand for food production. Robotic automation of existing farm machinery for agricultural field tasks that involve repetitive movements within defined boundaries has the potential to meet these demands. This thesis presents the design and implementation of path planning and following logic in robotic automation software, transforming modern tractors into fully autonomous robots.

Motivation

The Industrial Revolution introduced machines capable of producing hundreds of horsepower, transforming manual labor into mechanized power. Later, the integration of computers and electronic control systems enabled humans to manage and coordinate these powerful machines with greater precision.

Today, a new technological shift is emerging, driven by advances in artificial intelligence and robotic automation systems that aim to further enhance the capabilities of machines, enabling them not only to execute commands but also to perceive their environment, plan actions, and operate with greater autonomy. These technologies enable new levels of efficiency and functionality in farm field tasks.

Method

The experiment was conducted on the Robot Operating System 2 (ROS2) using various customized technology stacks. A Unified Robot Description Format (URDF) represents the specifications of a real tractor. The coverage planner generates waypoints for the rows based on the provided geographic coordinates. Global Navigation Satellite System (GNSS)-based localization enables global planning in large outdoor environments. The Navigation 2 (NAV2) global plan-

ner generates paths, and the local controller follows them. A ROS2 controller, based on the kinematic model of an Ackermann-steering vehicle, transforms NAV2 commands into torque-based commands for heavy machines and equipment weighing over 6 tons, and operates the robot in heavy-duty field tasks. Gazebo simulation with a heightmap and soil conditions reflects physical rules and allows testing the software under real-world scenarios. LiDAR-based obstacle detection ensures safety during task execution.

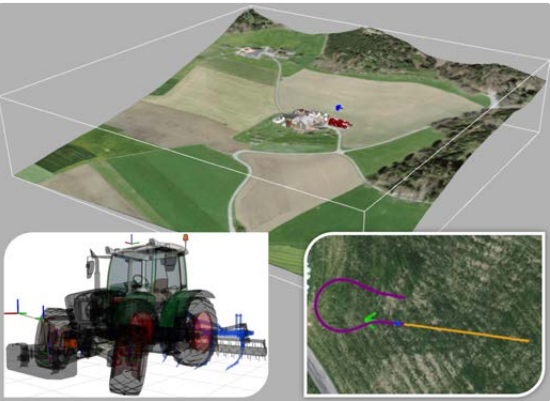
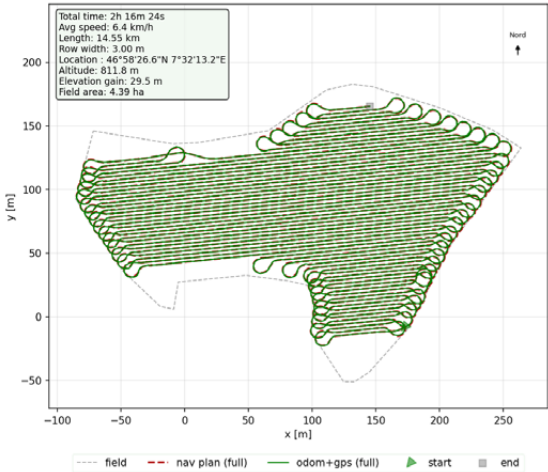


Mehmet Copur
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Result

On sloped surfaces, the robot behaves like a real machine, exhibiting traction loss, lateral slip, pitch-up, and torque loss. It stops when it detects obstacles and resumes when they pass. The NAV2 stack successfully creates and follows a path based on waypoints. Field tasks are completed autonomously, and path planning and tracking accuracy metrics indicate centimeter-level errors, with an RMSE of less than 20 cm in a 2-hour test run.

Source	Path	RMSE [m]	Max CTE [m]	Mean CTE [m]
ODOM+GPS	row subset	0.092	0.844	0.065
	full	0.187	0.844	0.127



URDF, MapViz and Gazebo Simulation

Path Following Evaluation

The Arch as a Structural and Form-Defining Element

Degree programme: Master of Science in Engineering

Specialisation: Civil Engineering

Thesis advisor: Prof. Dr. Stephan Fricker

Expert: Marcel Imbach (Equi Bridges AG)

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This thesis presents the design and structural analysis of a pedestrian bridge spanning the Aare River between Zehendermätteli and Bremgarten in Bern. The Aare river corridor demands engineering structures that are modest in appearance yet clear in structural intent. The shallow arch is intentionally chosen as the central load-bearing and form-defining element, combining structural efficiency with sensitive integration into a demanding environmental and geotechnical context.



Marco Eggimann

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Structural Concept

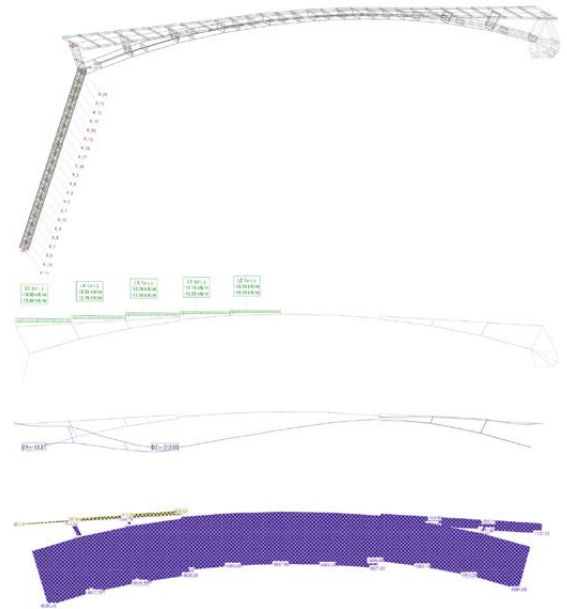
With a span of approximately 58 m and an arch rise of only 4.5 m, the resulting structure is an exceptionally shallow arch. This geometry leads to high axial forces, increased sensitivity to horizontal displacements, and a pronounced relevance of second-order effects. The bridge is designed as a fixed arch system with asymmetric structural behaviour. Differences in subsoil conditions on the two riverbanks are explicitly considered and decisively influence support conditions, load transfer, and deformation behaviour.

Methods

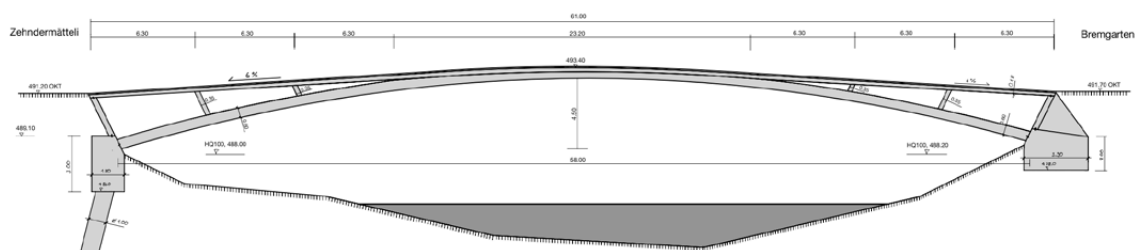
Several arch bridge typologies were studied and compared based on site-specific boundary conditions and selected reference projects. Design variants were assessed with respect to architectural expression, structural behaviour, sustainability, and economic performance. The final solution is a concrete arch bridge, offering a robust and durable structural concept with a calm and convincing appearance. The structural analysis includes all relevant ultimate and serviceability limit state verifications. The arch geometry is derived using a discrete catenary approach and implemented in a global structural model. Second-order effects are explicitly accounted for in the global structural analysis, while soil-structure interaction is represented by a nonlinear bearing and subsoil model to realistically capture foundation deformations. The dynamic behaviour of the bridge is investigated using a response spectrum analysis.

Findings

The study shows that the structural behaviour of such a shallow arch is governed by the interaction between superstructure and foundations. A clear structural concept combined with a conscious consideration of the ground conditions enables a robust, economical, and durable bridge that spans the Aare River with structural clarity and respect for its natural setting.



FEM-model with asymmetrical live load, deformations and normal force



Longitudinal section of the bridge showing the shallow arch geometry and the structural system

Strengthening Supply Conditions and Supplier Collaboration in Tactical Production Planning

Degree programme : Master of Science in Engineering
Specialisation : Business Engineering
Thesis advisor : Prof. Dr. Jörg Grimm
Expert : Romain Blaser (IBP Ready Sàrl)

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In regulated MedTech manufacturing, tactical production planning must be reliable and fast. Many plants operate in fragmented system landscapes where ERP outputs, corporate planning tools, and spreadsheets coexist. In such environments, producing a plan does not guarantee execution: limited visibility of supply conditions and poorly structured supplier signals drive manual reconciliation, reactive firefighting, and recurring shortages across competing demand streams.

Objective

This thesis addresses how supply conditions and supplier collaboration can be structurally strengthened at plant level under system fragmentation. It focuses on operationalising supply-condition visibility and execution feasibility in a way that also generates clear, supplier-usable planning signals.

Methods

Using a design science research approach in an embedded industrial case, a plant-level tactical planning artefact was designed, implemented, and evaluated. The artefact integrates:

- automated data-preparation workflows,
- a heuristic constraint-based Master Production Scheduling logic (cMPS), and
- a governed “single source of truth” planning file that consolidates assumptions, priorities, and constraints for cross-functional use.

A component-projection mechanism extends the framework by translating feasible production plans into time-phased material demand and highlighting emerging shortages and bottlenecks across competing demand streams.

To complement the internal planning perspective, semi-structured interviews were conducted with key suppliers to examine how planning signals are interpreted under volatility and constraint. The qualitative analysis identifies practical collaboration mechanisms aligned with suppliers’ execution realities.

Results

The results show that supply conditions can be strengthened through structured, time-phased visibility of capacity, WIP, and component risks, even without full ERP or APS integration. By stabilising data, making constraints explicit, and embedding planning logic into repeatable governance routines, the framework:

- reduces reliance on manual reconciliation,
- improves alignment between monthly planning and weekly execution, and
- increases transparency of material and capacity risks.

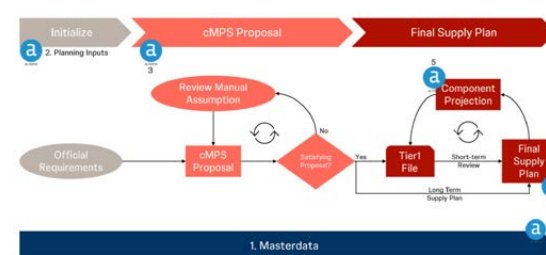
Supplier feedback confirms that strengthened internal visibility directly enhances external collaboration when translated into clear rolling forecasts, defined frozen horizons, explicit prioritisation rules, simplified interfaces, and feasibility-based confirmations.

Conclusion and Contribution

Overall, the thesis provides empirical evidence on how strengthening supply conditions and supplier collaboration can be achieved through disciplined planning-signal design rather than full digital integration. It contributes to research on supply chain visibility, tactical planning, and supplier collaboration by demonstrating how execution-feasible planning and supplier-usable signals can be operationalised in fragmented manufacturing environments.



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Planning Framework

Development of a high performance control system for PMAC motors

Degree programme : Master of Science in Engineering
Specialisation : Electrical Engineering
Thesis advisor : Prof. Dr. Sébastien Mariéthoz
Expert : Dr. Martin Veenstra (Hitachi Energy)

22

Electric motors can be classified based on the current they require to operate: direct (DC) or alternating (AC). Among the latter Permanent Magnet AC (PMAC) motors are widely used in high efficiency and power density applications. However, the achievable performance depends strongly on the setup used to drive the motor. The aim of this thesis is to explore solutions that can improve the system surrounding the electrical machine.



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Introduction

In a traditional PMAC drive system, a three-phase H-bridge inverter is used to supply the motor with voltages of variable amplitude and frequency. The converter is managed by a microcontroller with the main purpose to follow the desired control reference. To do this, in order to achieve optimal results, it is essential to know the position of the rotor accurately. Therefore, high-precision sensors are usually used, which, in addition to being subject to failures, increase the cost and volume of the system. In this project, the focus was placed on two aspects, namely, developing a superior power converter to interface the motor and investigate an alternative way of determining the rotor angle.

Designed power converter

To be able to control a wide range of motors, a 3-level T-type inverter rated for 15 kW with 800 V on the DC bus was built. Being a multilevel converter, it has better efficiency and harmonic distortion. Additionally, the use of Silicon Carbide (SiC) FETs allows the switching frequency to be further increased. Consequently, it is possible to improve the quality of the current flowing in the motor with a reduced stress on winding insulation.

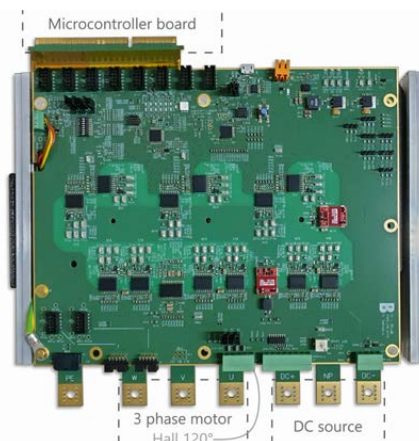


Figure 1 - Top view of the 3-level T-type converter prototype

Proposed control strategy

To control the motor, a Field Oriented Control scheme was implemented using the angle information obtained by combining low-resolution sensors with a sensorless approach.

Hall effect switch sensors are inexpensive and provide an absolute but coarse angle. By adding an observer, its results can be exploited to obtain a better estimate of the rotor position.

While being cost-effective, this solution also introduces a higher level of robustness and reliability to the control system.

Results and conclusion

Figure 1 shows the realized converter and how it integrates into a drive system. To validate the proper functioning of the inverter and the angle estimation, tests were performed with a small permanent magnet synchronous motor. Some waveforms obtained during motor start-up are shown in figure 2.

In conclusion, although under certain conditions, the two aspects addressed in this project were successfully combined and implemented, confirming their relevance for practical applications.

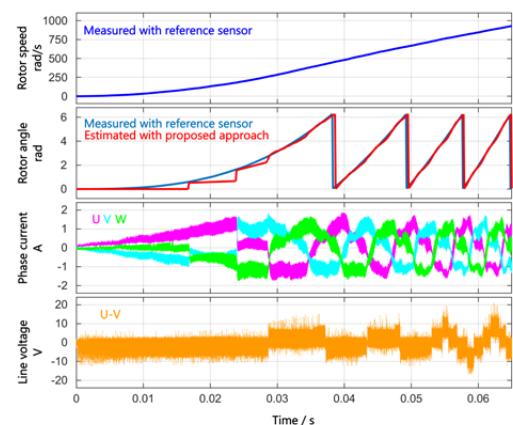


Figure 2 - Test results obtained using the developed system

From Concept Sketch to Prototype: Development and Validation of an Innovative PPE Product

Degree programme : Master of Science in Engineering
Specialisation : Energy and Environment
Thesis advisor : Prof. Dr. Priscilla Caliendo
Expert : Dipl.-Ing. (FH) Kerstin Kiy (Hochschule Furtwangen)

23

Personal protective equipment is used in a wide variety of areas and serves to protect the user from hazards in their environment. Protecting the sensory organs of the eyes and ears from damage is of particular interest in this context due to their importance to humans. The innovative way of integrating the two protective functions of eye and hearing protection in one product offers decisive advantages for the user.

Objectives

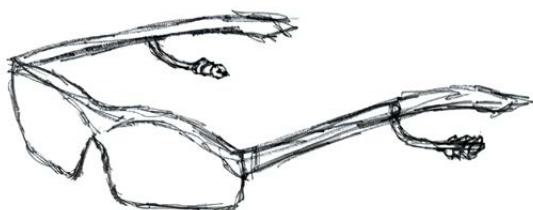
The aim of this thesis is to systematically develop a strategic prototype based on the basic product idea of combining eye and hearing protection. The result is a minimum viable product (MVP) that proves both the feasibility in terms of functionality and producibility and can also be used as a demonstrator for initial customers or investors. The aim of the thesis is thus embedded in the author's overarching goal of continuing the product idea in an entrepreneurial manner.

Methodological approach

The methodological framework for the subsequent practical implementation of product development is provided by the guidelines of the Association of German Engineers (VDI) 2221 and VDI 2222. Based on these guidelines, a specific product development process is derived in detail in the thesis, taking into account the development assignment and other contextual factors. Particular attention is paid to the permanent and early integration of the user in the design process.

Product Development Process

The core of the thesis is the execution of the specific product development process. A list of requirements is used to clearly define all the goals that the prototype should meet after development. In a total of seven steps, the vision thus defined is then translated from an idea into a physical prototype. Beginning with the highly creative, still largely unclear initial steps (fuzzy front end), the meaningful range of possible solution concepts is continuously narrowed down



Principle sketch of combination of eye and hearing protection

in constant comparison with the list of requirements, and the resulting concept is gradually developed in its components. Through the constant integration of tests and user feedback, the prototype is designed to meet requirements in numerous iterations. In addition to Computer-Aided Design (CAD) simulations, these steps are characterized by other rapid prototyping methods, such as 3D printing. Once all components have been designed in the final step, assembly follows and the prototype can be evaluated in terms of its target achievement in comparison with the list of requirements.

Results and Conclusion

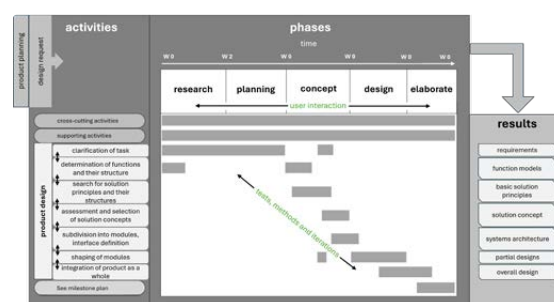
The resulting prototype fully or partially meets 18 of the 22 requirements. Only three requirements could not be met, one of which was exceeding the target weight by six grams. The interpretation of the target/actual comparison concludes that the prototype fully meets the initially defined functions of an MVP and that its properties are satisfactory to the developer. The thesis shows that existing optimization potential in the area of combined PPE can be effectively converted into a functional solution through systematic product development.

Outlook

The prototype serves as a solid starting point for the author to advance product development toward pre-series production.



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Specific product development process

Simulation of the Impacts of Photovoltaics in the Distribution Network

Degree programme: Master of Science in Engineering
Specialisation: Energy and Environment
Thesis advisor: Prof. Dr. Christof Bucher
Expert: Yamshid Farhat (BKW Energie AG)
Industrial partner: IWB (Industrielle Werke Basel), Basel

24

The rapid expansion of photovoltaic (PV) systems in urban low voltage grids challenges conventional grid planning. This study analyses a high PV penetration scenario in two urban distribution networks and evaluates mitigation measures that reduce voltage violations and component overloads, thereby limiting the need for conventional grid reinforcement.



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Background and Motivation

The expansion of decentralized photovoltaic (PV) generation in Switzerland is accelerating, particularly in urban low voltage distribution networks. In the Canton of Basel-Stadt, this development is further driven by the Solaroffensive initiative, which targets increased solar power generation by 2037. Distribution networks originally designed for load-dominated operation are increasingly exposed to concentrated PV feed-in peaks, creating new challenges for grid operation and planning.

Objective

This thesis analyses the impacts of a high PV penetration scenario on two urban low voltage distribution network areas operated by the local distribution system operator. The effects on asset utilization, voltage levels, and network losses are quantified, and mitigation measures to ensure compliant grid operation are evaluated. Current network conditions in 2024 are compared with a future scenario for 2037 assuming widespread rooftop PV deployment.

Methodology

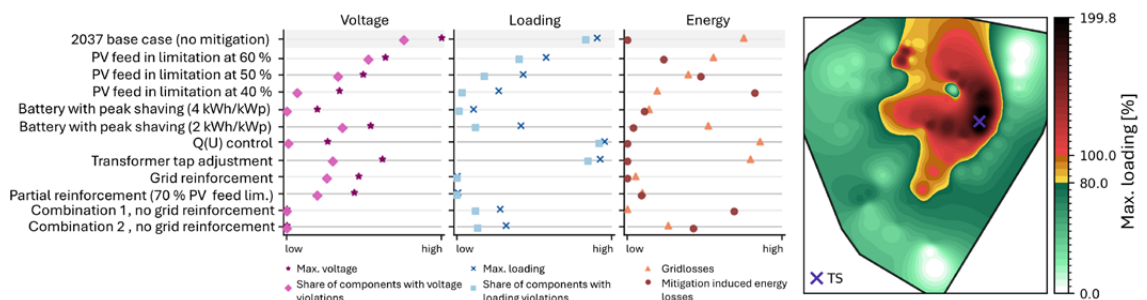
Steady-state, time-discrete power flow simulations with a 15-minute resolution over a full year are conducted using real network models, smart meter data, and simulated PV generation profiles based on meteorological data. Network performance is assessed using indicators such as component loading, voltage deviations, and energy losses.

Results

While no limit violations occur under current network conditions, the 2037 scenario leads to significant voltage rises and thermal overloads of transformers and nearby assets during PV generation peaks. Without mitigation, grid reinforcements affecting approximately 30 % of the total cable length would be required. Feed-in power limitations reduce thermal overloads, with no limit violations between 30 and 40 % limitation levels. However, a 40 % limitation results in energy losses of about 18 % of annual PV generation. Battery storage systems provide relief only when combined with suitable control strategies, whereas load shifting has a minor impact. Voltage control measures reduce voltage violations but may increase component loading and network losses. Combining multiple measures proves most effective.

Conclusion

High PV deployment without mitigation leads to non-compliant operating conditions in urban distribution networks. Targeted combinations of technical measures can substantially reduce grid stress and defer or avoid conventional grid reinforcements. The developed methodology supports measure-oriented distribution network planning and enables quantitative evaluation of future grid operation strategies.



Comparison of mitigation measures (left) and georeferenced peak component loading levels in 2037 for the first investigated network area (right)

SLAM using 3D Gaussian Splatting

Degree programme : Master of Science in Engineering
Specialisation : Mechatronics and Automation
Thesis advisor : Prof. Dr. Norman Urs Baier
Expert : Dr. sc. nat. Elias Rüfenacht (Ypsomed AG)

25

Semantic understanding of the environment is essential for intelligent robotic systems. Therefore, a detailed and interpretable map forms a fundamental building block for a comprehensive world model. Typical maps used in mobile robotics lack detail and visual fidelity. This thesis develops a system that uses 3D Gaussian Splatting as a photo-realistic environment representation in a SLAM (Simultaneous Localization and Mapping) application.

Introduction

Typical state-of-the-art Simultaneous Localisation and Mapping (SLAM) algorithms in mobile robots either use simple occupancy maps or sparse feature maps to represent the environment. Because these maps lack visual fidelity or dense representation, they are only used in the SLAM problem itself. Modern learning-based algorithms can represent an environment with high visual fidelity using radiance fields. 3D Gaussian Splatting (3DGS) is among the first algorithms to enable learning of a radiance field, with an explicit and interpretable representation, in real-time. This enables the semantic understanding of an environment using modern image processing models for many higher-level tasks. In this thesis, a complete technology demonstrator is developed, that implements a 3DGS model as the map representation in a SLAM algorithm.

Methodology

To simulate a mobile robot or a drone, a handheld device equipped with a Raspberry Pi and a RealSense depth camera was developed. For the tasks requiring significant computational power, a stationary PC with a GPU is used. The SLAM algorithm is implemented as an Extended Kalman Filter that fuses high frequency IMU measurements with the pose from the

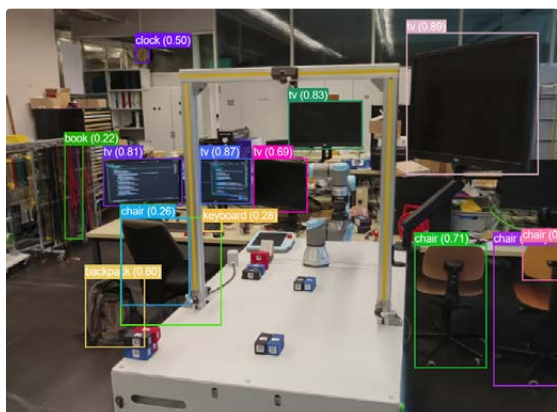
localisation of a camera view on the map. The map is implemented as the 3DGS model that represents the radiance field of the environment. Using a captured image, the localisation is achieved through the simultaneous optimisation of the camera-pose and the 3DGS representation. This optimisation is done with standard machine learning algorithms that run on the GPU.

Results

Our system can solve the SLAM problem, using the 3DGS model as the sole representation of the environment. We capture and integrate camera frames into the 3DGS model at a rate of 5Hz. As shown in the figure, a synthetic view generated from the 3DGS model achieves sufficient visual fidelity to enable processing with state-of-the-art image recognition and object detection algorithms. The developed system works under most real-world conditions. There are well-known computer vision issues which apply to our system. If the captured environment lacks texture (pure white wall), is repetitive (brick wall), or the images get motion-blurred, the pose estimate from the localisation degrades. This, in turn, leads to a poor map that causes the SLAM algorithm to diverge from reality.



Lorin Jenkel



Synthetic view, rendered from the 3DGS model; Objects detected with YOLO3.

Conclusions and Outlook

The demonstrated real-time generation of a detailed, high-fidelity map enables a single environment representation to be used in classical SLAM algorithms, as well as to form a fundamental building block in the semantic understanding of the environment for intelligent robotic systems. In a next step, the system can be integrated in a mobile robot, instead of a handheld device. Future research includes the integration of semantic information into the 3DGS model directly, which could improve the understanding of the environment even further.

Immersive Neuro-Rehabilitation Physiotherapy on Motor-Sensopro Platform

Degree programme: Master of Science in Engineering
Specialisation: Mechatronics and Automation
Thesis advisors: Prof. Dr. Juan Fang, Prof. Dr. Efe Anil Aksöz
Expert: Fabian Rüegg (Sintegrity Rüegg Engineering GmbH)
Industrial partner: Sensopro AG, Münsingen

26

Building on the principle of enriched environments, approaches incorporating multisensory stimulation have been shown to further enhance neuroplasticity during motor training. At BFH-TI rehaLab, an innovative robotic balance training platform prototype was developed. This thesis investigates the possibility of enhancing the user interactive experience on it, with the creation of an immersive virtual environment along with physio training modalities to be implemented.



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Context

In post-stroke rehabilitation, physiotherapists often use repetitive walking practice, balance exercises to promote recovery and thus improve functional mobility. Motor-Sensopro is developed to train balance-maintenance ability for patients with motor impairments. It includes a BWS system and a pair of motorized foot platforms allowing 3-DOF movements for the lower limbs. A front-faced high-format screen is intended to provide biofeedback.

Motivation

The thesis developed intuitive physio training that incorporates IMU sensors and new elastic foot platforms, and also explored ways of enhancing the user experience through a virtual environment that promotes synchronous biofeedback and sensory immersion. In order to foster enjoyment, progression, training motivation, and thus propensity for neuromotor relearning, the current project seeks to integrate visual & auditory cueing elements within an engaging sequence of physiotherapeutic movements.

Objectives

1. Development of a proof-of-concept training series, combining passive and active new modes in an automated movement sequence.
2. Inclusion of interactive and biofeedback immersion for multisensory stimulation: auditory and visual components.
3. Integration of elastic-band footplates and IMU sensors into the system.
4. Comparison of muscle activity during training using stiff and elastic-band footplates respectively.

Methods

Aside from PLC programming for designing an automated sequence of training, python was used through ADS connection to read IPC variables. 3D rendering with Pygame-OpenGL was adopted for vision elements on the frontal screen. IMU data hub

was accessed using Foxglove-WebSocket protocol and ROS2 message from IMU data stream reconstructed. To get muscle activity, EMG measurements were performed using wireless electrodes placed on representative lower limbs muscles of a healthy participant and Cometa Systems acquisition software (Fig. 1).

Results

A training sequence including challenging active training modes was elaborated, tested using both foot platforms. Biofeedback indications of the current state of training is provided in real-time. Auditory and visual cues supported the trainer during the session. EMG signals analysis showed a 2-fold increase in lower limbs muscles activity using the new elastic-band footplates. Additional features like a jump function and visual rendering of IMU sensors orientation were implemented. Moreover a first sketch of interactive exergame was created.

Outlook

This contribution to Motor-Sensopro prototype development opens up new opportunities validating the promising potential of elastic-band footplates usage with balance and physio training. Further work could integrate new functions such as an obstacle avoidance exergame, or evaluate motivation & immersive aspects during the training sequences using a Flow State Scale questionnaire with voluntary and healthy participants.



Fig. 1: Training session during EMG measurements performed, using newly integrated elastic foot platforms (see MTh video)

Investigation of AZCS converter as solid-state transformer

Degree programme : Master of Science in Engineering
Specialisation : Electrical Engineering
Thesis advisor : Prof. Dr. Sébastien Mariéthoz
Expert : Dr. Martin Veenstra (Hitachi Energy)

27

Solid-state transformers (SST) are one of the most promising technologies in the energy sector today, emerging as a key element of the distribution systems of the future. This technology could replace conventional transformers, offering a range of benefits in terms of power density, energy efficiency and controllability. The focus of this thesis is the analysis of performance and the implementation of control strategies for a specific converter topology used as an SST.

Introduction

This thesis focuses on the AZCS (Active Zero Current Switching) converter (see fig.1) conceived by Prof. Dr. Sébastien Mariéthoz and its use as an SST, a combination of fast power converter and high frequency transformer. The main goal of the AZCS is to allow the converter to operate under soft-switching conditions, thereby reducing losses associated with the semiconductors commutation. This would improve efficiency and allow for higher switching frequency and power density. The objective of the project is, first, to experimentally validate the converter losses and determine whether optimal switching conditions have been achieved. In a second phase, it is to define use scenarios and implement the control strategies necessary to fulfill the defined functional requirements.

Waveform validation and loss measurement

After conducting functional tests on the prototype, the basic control functions necessary to perform the waveform validation were implemented—first through simulation and then on the real setup by modifying the control software and the hardware setup. Once the measured waveforms and switching conditions were validated (see fig.2), power profile tests were carried out to measure system losses using a power analyzer. These tests were conducted at a fraction of the rated power and at different operating conditions. Analysis of the measurement results and comparison with the estimated losses calculated based on models of the various converter components revealed the presence of residual switching losses despite optimal commutation conditions.

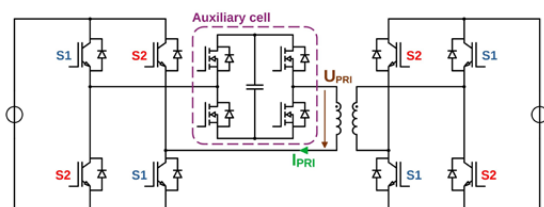


Figure 1 - Basic topology of the AZCS converter. The auxiliary cell enables soft switching and optimal current waveforms

Implementation of control strategies

First, a use scenario was defined, based on which the functionalities that the converter must provide were described. Secondly, thanks to the knowledge of the converter's dynamics and the relationships between the various parameters—gained through simulation analysis and experimental measurements—an initial control structure was designed to meet the defined functional requirements. The design and testing of the control structure were carried out via simulation before proceeding to tests on the actual setup. In addition, further control options have been identified and highlighted for investigation that could potentially help improve the converter's control and performance.

Conclusion

The losses measurements produced a result different from what was expected, suggesting the existence of residual switching losses even under apparently optimal switching conditions. This aspect will need to be further analyzed through the implementation of a new prototype and the use of different semiconductor technologies. The control structure currently implemented meets an initial set of defined requirements and can be improved through a series of modifications that have been identified and described.

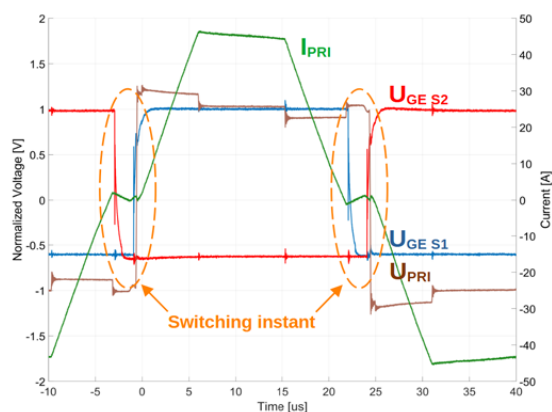


Figure 2 - Switches control signal (blue and red), transformer primary current (green) and voltage (brown)



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Data Acquisition Strategy to enable Digital Product Passport – A Case Study on PV Modules

Degree programme : Master of Science in Engineering
Specialisation : Business Engineering
Thesis advisor : Prof. Dr. Stefan Grösser
Expert : Moritz Maier (Berner Fachhochschule)

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This thesis develops and validates a data acquisition strategy to operationalize Digital Product Passports (DPPs) in the PV sector. It contributes (1) a four-layer acquisition framework, (2) a prioritization model for key data attributes, and (3) an empirically evaluated pipeline using heuristic and LLM-based extraction methods to enable scalable, data-driven circularity.



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Introduction

The rapid global expansion of photovoltaic (PV) installations is expected to generate up to 60–80 million tons of PV waste by 2050, creating major challenges for recycling and circular resource use. Effective reuse depends on high-quality lifecycle data, yet the PV sector is characterized by fragmented information flows, low transparency, and limited data availability. Digital Product Passports (DPPs) offer a promising solution by enabling structured, lifecycle-wide data access in a structured, transparent, and scalable manner. However, their implementation is constrained by unclear data ownership, missing identifiers, limited incentives for data sharing, and the absence of systematic data acquisition strategies. While prior research has focused on DPP concepts and requirements, there is limited work on how required data can be reliably sourced, structured, and integrated in practice.

Goals

This thesis addresses this gap by designing, evaluating, and partially implementing a data acquisition strategy for a PV-specific DPP within the EU-funded RETRIEVE project in real applications. Based on 13 semi-structured expert interviews, nine key data attributes are identified and mapped to lifecycle stages, data owners, and sources. A prioritization model evaluates attributes based on availability, extraction effort, and expected circularity impact, identifying material composition per component as the most feasible starting point. To validate the approach, 15 EPD platforms were analyzed and 13 Environmental Product Declarations (EPDs) from the EPD International platform were processed. An automated pipeline combining web scraping and PDF processing is implemented, comparing three extraction approaches: a heuristic method (referred to as the traditional method), a hybrid method (heuristics + LLM), and a fully LLM-based method.

Results

The findings show that most DPP platforms lack clearly defined acquisition strategies and rely primarily on externally provided data, leading to significant data gaps. A four-layer data acquisition framework is developed, linking lifecycle stages, data attributes, capture technologies, and acquisition methods. The prioritization model shows that material composition data has high impact for recycling decisions and moderate feasibility due to its availability in standardized sources such as EPDs. The empirical evaluation (N = 13 EPDs, manually constructed ground truth with defined fields and a held-out evaluation) reveals substantial performance differences (Figure 1): the heuristic method achieves 56% overall correctness, the hybrid method 77%, and the fully LLM-based method 97% field-level accuracy. The LLM-based approach consistently outperforms alternatives in structural and semantic accuracy and achieves complete extraction of all modules per document. While the evaluation is bounded to EPDs as a document class, the results demonstrate that LLM-based extraction can convert unstructured lifecycle documents into DPP-ready structured data at accuracy levels sufficient for downstream circularity decisions. This highlights that technical data extraction is no longer the primary constraint for DPP implementation. Instead, the main bottlenecks shift toward data governance, standardization, and incentive design, providing actionable insights for DPP systems in the PV sector and beyond.

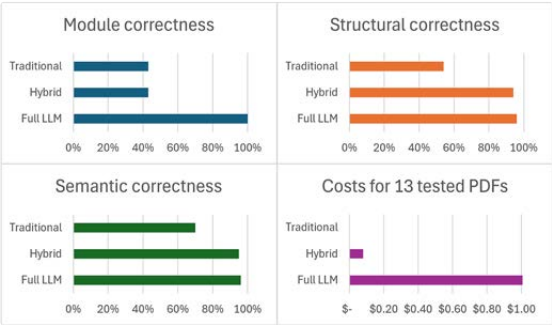


Figure 1: Performance results of the three methods



FloCo AI: Redesigning Human–LLM Interaction for Document-Centered Workflows

Degree programme: Master of Science in Engineering
Specialisation: Data Science
Thesis advisor: Prof. Dr. Erik Graf
Expert: Achim Kohli (amaise)

30

Currently, most human-LLM interaction occurs via chat interfaces. Based on consultations with industry experts, there is a clear need for a new generation of user interfaces. This is why FloCo AI was created: an innovative user interaction paradigm for document-centred workflows. An A/B test comparing FloCo AI with a state-of-the-art LLM chatbot revealed that participants achieved greater efficiency and produced more consistent quality with FloCo AI.



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Context and Motivation

The current user interfaces, which are predominantly chat-based, are not well adapted for processing and interacting with documents. From previously conducted projects and dedicated interviews with industry experts, requirements for a new generation of user interfaces could be gathered.

FloCo AI

A new user interaction paradigm has been developed, leading to the creation of a fully-functional prototype called FloCo AI. Figure 1 illustrates the core functionalities of FloCo AI. The „Playground“ feature (top of figure) enables users to experiment with one document at a time and allows users to specify what they are looking for directly in the document. The „Tools“ function (bottom of figure) enables users to save processing behaviour for reuse on multiple documents and collaboration, with innovative verification and

correction features. Furthermore, the modular architecture allows for integration with any LLM provider and backend AI capabilities.

Evaluation

Feedback was collected iteratively throughout the development of FloCo AI, and an A/B testing was also conducted in order to quantify performance. This involved comparing the new user interaction paradigm proposed by FloCo AI and a state-of-the-art LLM chatbot user interface. Twenty-three participants completed an entity extraction task with documents. The results were very positive: FloCo AI was more efficient and produced more consistent quality, and its user interaction was generally preferred over the standard chat user interface. Following the A/B test, feedback was gathered from industry experts, all of whom agreed on the relevance of the new user interaction paradigm suggested by FloCo AI.

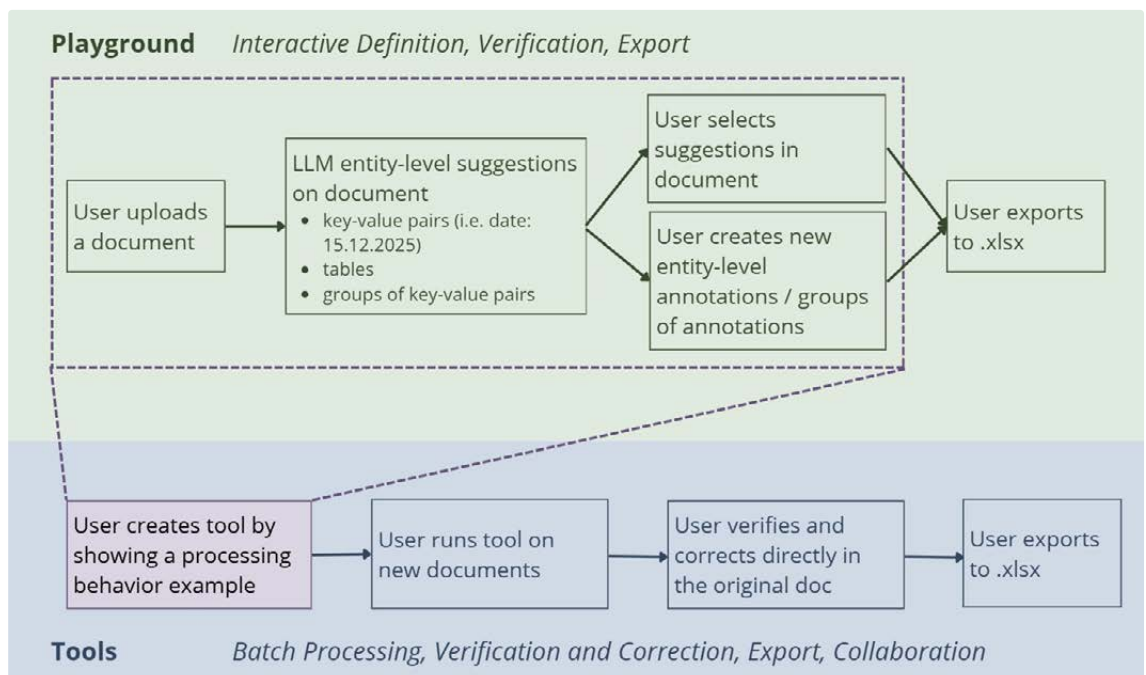


Figure 1 FloCo AI's Architecture

Development of an Automatic Slicing and Packaging System for Tête de Moine Rosettes

Degree programme : Master of Science in Engineering

Specialisation : Mechatronics and Automation

Thesis advisors : Prof. Dr. Gabriel Gruener, Prof. Dr. Raphael Rätz

Expert : Prof. Dr. Marcel Honegger (ZHAW School of Engineering, Institute of Mechatronic Systems)

Industrial partner : Fromages Spielhofer SA, St-Imier

31

Few gestures are as simple as turning a girolle - or as hard to reproduce at scale. Scraped by hand, delicate rolled rosettes of Tête de Moine can be formed; yet producing uniform rosettes industrially is far more difficult. This thesis analyses today's production to understand the differences between mass-produced and hand-scraped rosettes with the aim of proposing process improvements.

Introduction

Tête de Moine is a Swiss AOP cheese, a specialty first made by the monks of Bellelay Abbey. This cheese is not eaten in slices but as rosettes: thin, ruffled shavings that look like delicate flowers, scraped off the cheese wheel by hand with a girolle. If a household has a girolle, fresh rosettes can be scraped at home. However, most households do not have a girolle, which is why producers offer pre-packaged machine-scraped rosettes. The availability of pre-packaged Tête de Moine rosettes has made them popular beyond Switzerland with strong market growth in Europe and North America.

The current rosette scraping machine uses a spring-loaded blade on a rotating cheese wheel adjusted by three parameters. After the machine scrapes the cheese, operators pick the rosettes by hand and arrange them neatly into a tray. The downside of this industrial process is that the produced rosettes are visually less attractive than the hand-made ones. Moreover, manually filling the trays is labour-intensive.

Goal

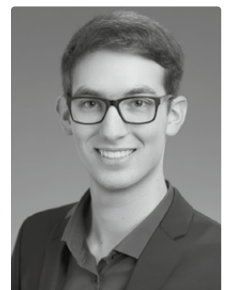
The industrial production of Tête de Moine rosettes was examined to understand the limitations of the current process and to suggest improvements.

Methods

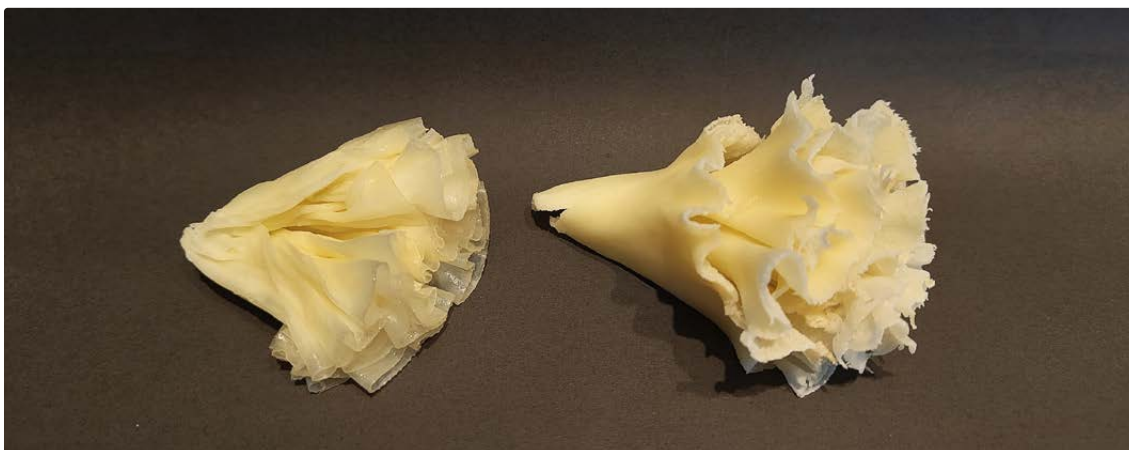
Hand-made and machine-scraped rosettes were compared to determine their differences. Rosettes were cut under controlled conditions, varying temperature, cutting speed, and blade pressure. The results were qualitatively compared to determine the influence of these parameters.

Results

Hand-scraped and machine-scraped rosettes show important differences. Trade-offs between different parameter settings can be observed. Slower scraping speed results in visually appealing rosettes but lowers throughput. Shaving the cheese in a horizontal position rather than vertically improves the flower shape but makes automating the packaging of the rosettes more difficult. If the machine parameters could be set more precisely than what the current equipment allows, the quality of the machine-scraped rosettes would be improved.



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Industrial, machine-scraped compressed rosette (left) versus a hand-scraped rolled rosette (right).

Implementation of a Chatbot for Downtime Data Analysis Using Retrieval-Augmented Generation

Degree programme: Master of Science in Engineering
Specialisation: Data Science
Thesis advisor: Prof. Dr. Jürgen Vogel
Expert: Prof. Dr. Daniele Puccinelli (SUPSI)
Industrial partner: Hoffmann Neopac AG, Oberdiessbach

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Manufacturing companies collect large amounts of production data, yet valuable insights often remain hidden in complex systems and free-text records. This project demonstrates how a chatbot leveraging Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG) can facilitate natural language access to downtime data, reduce analytical effort, and support data-driven decision-making in an industrial environment.



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Introduction

Manufacturing Execution Systems (MES) generate large volumes of structured and unstructured data that are essential for analyzing production performance and machine downtimes. At Hoffmann Neopac AG, a leading producer of plastic and laminated tubes, analyzing this data remains time-consuming and requires specialized knowledge. To address this challenge, this project develops a chatbot prototype that applies LLMs in combination with RAG to provide efficient and user-friendly access to MES downtime insights.

Objectives

This master's thesis builds on previous work and advances an existing chatbot prototype. The project pursued three objectives: evaluating alternative LLMs, establishing a test environment for user feedback, and improving the user experience through targeted interface enhancements.

Methods

A structured methodology combining data preparation, system extension, and evaluation was applied. The chatbot was implemented using a modular, containerized architecture with a Neo4j graph database, a FastAPI-based backend, a feedback API, and a Streamlit frontend.

The backend supported both serverless and locally hosted LLMs to allow consistent comparison under identical conditions. Model performance was evalu-

ated using accuracy and RAG-specific metrics, as well as system indicators such as inference time and cost. The system was deployed in a containerized Azure environment for user testing, followed by a System Usability Scale (SUS) survey to assess usability and user acceptance after a four-week test phase.

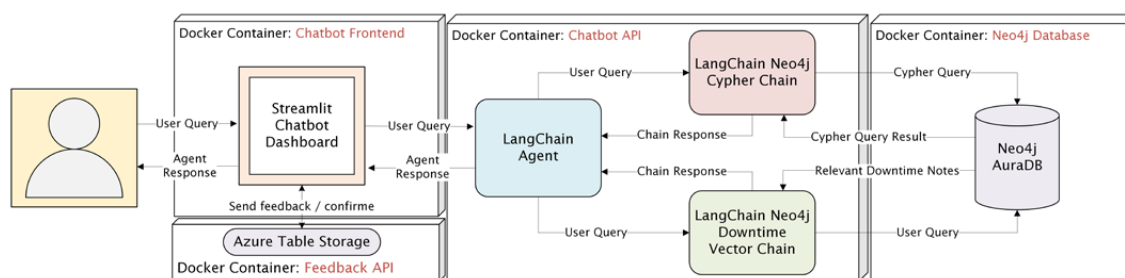
Results

The results show that serverless models achieved higher accuracy and more stable RAG-specific scores. Lightweight models such as GPT-4o-mini provided a strong balance between answer quality, inference time, and cost and were therefore selected for user testing.

The chatbot achieved an average SUS score of 70.83, slightly above the common benchmark of around 68, indicating good usability without the need for extensive technical training. User testing further revealed gaps between technically correct answers and perceived usefulness, especially for unclear or domain-specific queries, highlighting the importance of transparency and usability alongside model performance.

Conclusion

This work shows that combining LLMs with RAG enables efficient and user-friendly access to MES downtime data in an industrial context. The findings also emphasize that system design, usability, and continuous user feedback are key factors for successful productization.



Flowchart of LLM RAG Chatbot for MES Downtime Data

Warm Mix Asphalt with 50% RA: Performance, Optimization, and Sustainability

Degree programme: Master of Science in Engineering
Specialisation: Civil Engineering
Thesis advisor: Prof. Dr. Dirk Proske
Expert: Prof. Dr. Nicolas Bueche (IMP Bautech AG)
Industrial partner: BSL Baustofflabor AG, Uetendorf

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Reducing asphalt mixing and paving temperatures while increasing the use of reclaimed asphalt (RA) responds to two key challenges in pavement construction: lower greenhouse gas emissions and reduced demand for primary aggregates and virgin binder. This thesis evaluated whether warm mix asphalt (WMA) with 50% (RA) can achieve performance comparable to a hot mix asphalt and provide a practicable route towards more circular asphalt pavement construction.

Motivation

The combined use of reduced temperatures and high RA content is promising but technically demanding. RA reduces the demand for primary aggregates and virgin binder, while WMA technologies reduce the thermal load during production and paving. However, high RA contents introduce uncertainty related to aged binder, RA homogeneity, binder blending, workability and compaction behaviour. Thus, the key question is whether WMA with 50% RA can lower emissions while achieving credible performance within the Swiss quality framework for asphalt concrete.

Assessment

The study was based on plant-produced mixtures and a field test section, allowing laboratory results to be linked with practical paving conditions. Three AC T 22 N mixtures with 50% RA were produced and paved: a conventional hot mix asphalt (HMA) and two warm mix asphalt variants using foamed bitumen and a chemical additive. Field observations covered temperature development, workability, compaction and visual emissions during paving. The laboratory programme included gradation and soluble binder content, volumetric properties, gyratory compaction, Marshall testing, indirect tensile strength, water sensitivity, uniaxial cyclic compression testing and conventional as well as rheological testing of recovered binder. Because no Swiss criteria specifically address WMA with high RA content, com-

pliance was assessed against SN EN 13108-1 and VSS 40 430, the available framework for conventional asphalt concrete, recovered binder and field cores.

Practical Relevance

The investigated WMA mixtures with 50% RA achieved performance comparable to the HMA reference under the studied conditions. Gradation, soluble binder content, recovered-binder properties, compactability and key mechanical indicators showed no technology-specific deterioration. Field cores confirmed adequate in-situ compaction, with void contents and degrees of compaction assessed as compliant. Water sensitivity testing confirmed satisfactory resistance to moisture-related damage. The simplified greenhouse gas assessment identified RA as the main driver of emission reduction: HMA with 50% RA reduced the impact from 79 to 57 kg CO₂-eq/t compared with HMA without RA, while WMA further lowered it to 55 kg CO₂-eq/t. Reliable implementation requires stable plant temperature control, consistent RA quality, defined compaction windows, suitable logistics and performance oriented assessment. Further validation should address ageing, fatigue, low-temperature cracking and measured paving emissions. Overall, WMA with 50% RA is technically credible when environmental gains are matched by controlled production and durable pavement performance.



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Field test section: paving, loose asphalt mix sampling and core extraction



Laboratory programme: specimen preparation, binder recovery and performance testing

SiC Traction Inverter for a Formula Student Race Car

Degree programme: Master of Science in Engineering

Specialisation: Electrical Engineering

Thesis advisor: Prof. Dr. Andrea Vezzini

Expert: Lukas Menzi (BorgWarner Engineering Services Switzerland AG)

Industrial partner: Bern Racing Team, Biel

34

Formula Student race cars need drivetrains that are as light, compact and efficient as possible. The custom traction inverter developed in this thesis for the Bern Racing Team drives all four wheel motors from a single, air-cooled unit. Built around silicon-carbide power modules, it replaces two heavier commercial inverters and is designed to save more than 10 kg while improving drivetrain efficiency.



Yannick Strahm

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Introduction

The Bern Racing Team currently relies on two commercial dual-channel inverters weighing about 13 kg combined. Because every kilogram and every liter counts in a race car, the goal is a purpose-built inverter that is lighter, smaller and more efficient. Silicon-carbide (SiC) semiconductors promise lower losses than established IGBTs, and air cooling lets the inverter run without coolant, radiator or pump, a first step toward the fully air-cooled drivetrains becoming a trend in Formula Student.

Concept

The inverter integrates four Infineon CoolSiC six-pack 1.2 kV power modules on a single board with a shared DC link, providing one three-phase output per motor and delivering up to 35 kW at a peak phase current of 61 A RMS, within the 600 V Formula Student limit. Every channel has its own microcontroller, gate-driver stage and heatsink, while a central radial fan supplies the airflow. Phase-current, resolver, DC-link voltage and temperature sampling run on hand-written C firmware, while the field-oriented control (FOC) was modeled in Simulink and integrated as generated C code. The SiC modules enable a high 32 kHz switching frequency while keeping losses low.

Goals

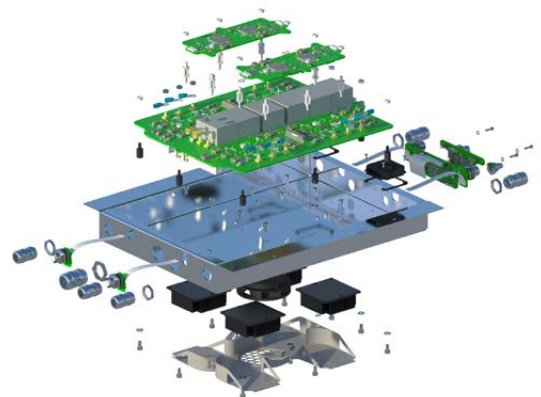
- finalize the inverter hardware, mechanical integration and thermal design
- assemble and commission the four-channel inverter
- develop firmware for control, protection and CAN communication
- validate the system on a test bench and, ultimately, in the race car

Results

The complete schematic, PCB layout and mechanical housing were designed in CAD. A single-channel prototype was built and put into operation. Double-pulse tests were used to select the gate resistors and to characterize the switching behavior and dead-time. The prototype first drove an inductive load using V/f and I/f control, followed by field-oriented control of a permanent-magnet motor. The final four-channel inverter weighs around 2.5 kg, more than 10 kg lighter than the previous solution and about half the volume. It is now installed in the race car, which is being prepared for competition.



The Bern Racing Team's Formula Student car, in which the inverter is currently validated.



Exploded view of the inverter: HV power board, control boards, heatsinks and central radial fan.

Der Strecke auf der Spur

Studiengang: Master of Science in Engineering

Vertiefung: Civil Engineering

Betreuerin: Prof. Marion Doerfel

Expertin: Sarah Weber

Industriepartner: Kanton Aargau Departement Bau, Verkehr und Umwelt - Abteilung Tiefbau - Verkehrsmanagement, Aarau

35

Auf einem ausserörtlichen, kurvenreichen Streckenabschnitt im Kanton Aargau ist seit mehreren Jahren ein überdurchschnittlich hohes Unfallgeschehen festzustellen. Vor diesem Hintergrund wurde die Strecke im Rahmen einer umfassenden verkehrssicherheitsbezogenen Untersuchung analysiert. Ferner erfolgte die Vertiefung der wissenschaftlichen Grundlagen des Geschwindigkeitsdiagramms.

Ausgangslage

Auf der ausserorts gelegenen, kurvenreichen Strecke werden seit mehreren Jahren auffällig viele Verkehrsunfälle registriert. Zudem gelten einzelne Kurvenbereiche als Unfallhäufungsstellen. Die bereits punktuell umgesetzten Massnahmen zeigten zunächst Wirkung, konnten das Unfallgeschehen jedoch langfristig nicht nachhaltig reduzieren. Im Rahmen der Masterthesis sind eine umfassende Analyse der Strecke sowie Massnahmenvorschläge zu erarbeiten.

Vorgehen

Zur Bearbeitung der Problematik wurde folgendes Vorgehen gewählt

- Befahrung und Dokumentation des Projektperimeters mittels Videoaufnahme zur Erfassung des Streckenverlaufs und relevanter Randbedingungen,
- Konstruktion des Geschwindigkeitsdiagramms auf Basis der erhobenen Streckendaten sowie dessen Auswertung,
- Streckenanalyse, u.a. Auswertung und Interpretation von Geschwindigkeitsmessungen auf Grundlage eines selbst entwickelten Messkonzeptes,
- Analyse BSM* der Unfallhäufung Brunnematt (Abb. 1 gelb)

(*Black Spot Management)

Ergebnisse

Aus der Auswertung des Geschwindigkeitsdiagramms (Abb. 2) geht hervor, dass die bestehende Linienführung in einzelnen Abschnitten zu ausgeprägten Geschwindigkeitsübergängen führt. Aufgrund der eingeschränkten Einsehbarkeit des weiteren Streckenverlaufs können Fahrzeuglenkende diese Übergänge unter Umständen erst spät erkennen, sodass eine Verzögerung nur noch durch Bremsbetätigung möglich ist. Für die Kurve Brunnematt konnten ferner die örtlich massgebenden Sicherheitsdefizite an Strassenanlage, Umfeld und Verkehrsablauf abgeleitet werden, welche das Unfallgeschehen mitbeeinflussen können. Es werden Massnahmenvorschläge unterbreitet, um die Verkehrssicherheit zu erhöhen.



Lina Tarabishi



Abb. 1 Staffeleggstrasse (blau) und Kurve Brunnematt (gelb)
Luftbild, Unfallkarte und Ausschnitt Fahrerperspektive

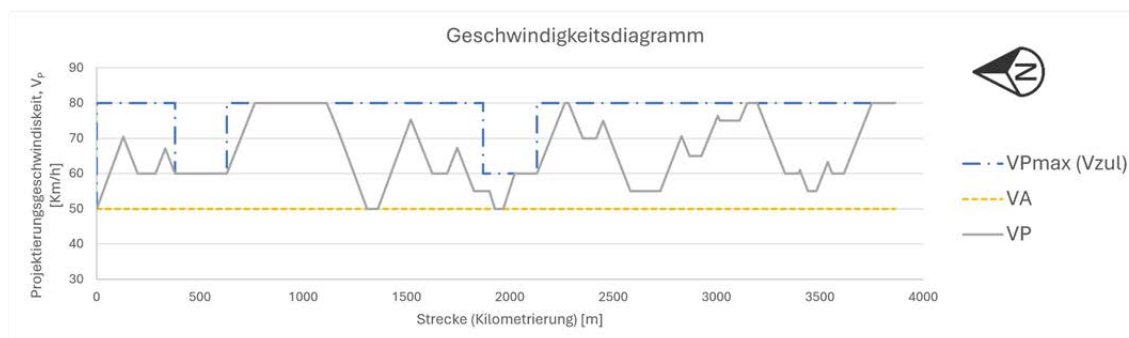


Abb. 2 Geschwindigkeitsdiagramm über den Streckenabschnitt

PactSmith: An open-source digital contract management solution for academic administration

Degree programme: Master of Science in Engineering
Specialisation: Computer Science
Thesis advisor: Prof. Andreas Habegger
Expert: Rico Zoss (Wabtec Corporation)

36

Electronic signatures alone cannot address the inefficiencies across the entire digital contract lifecycle, which spans template management, creation, data population, signing, and archiving. This work presents an open-source digital contract management application engineered to streamline workflows and meet the compliance needs of university student administration, offering an end-to-end solution for contract management.



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Introduction

Managing academic agreements, such as research contracts, non-disclosure agreements, and enrollment forms, often relies on disjointed, manual workflows scattered across multiple tools and applications. To address these administrative challenges, this project targets digital contract management in the context mentioned. Before development began, existing market solutions were evaluated through a rigorous analysis of component-origin decisions (build vs buy) in software engineering. This approach ultimately justified the development of a custom-built application tailored to the specific operational constraints of student administration.

Core Functionality

- **Tailored Template Management:** The application provides the ability to build a repository for standardized organisational templates managed by an ABAC approval flow. It allows administrators to maintain approved templates, eliminating repetitive drafting and ensuring institutional consistency.
- **Automated Contract Creation:** Users can generate new contracts efficiently by utilizing templates. Dynamic variable insertion allows the system to instantly map user-specific data without altering the foundational legal text. Additionally, a dedicated batch mode allows users to rapidly generate large volumes of documents simultaneously, significantly reducing administrative overhead.
- **Collaborative Multi-Party Input:** The platform features a collaboration environment where users can asynchronously access the document to populate required fields. ABAC ensures that parties work only with the part they have been assigned to,

while administrative users always have an overview of the state.

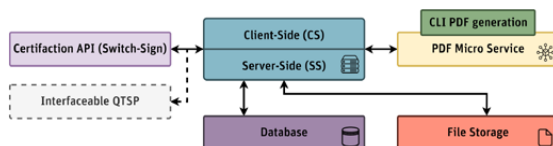
- **Compliant QTSP Signatures:** To guarantee the legal validity of faculty agreements, the application integrates with Qualified Trust Service Providers, which enables advanced, qualified electronic signatures, ensuring that all digital authorizations meet stringent regulatory standards.

System Architecture

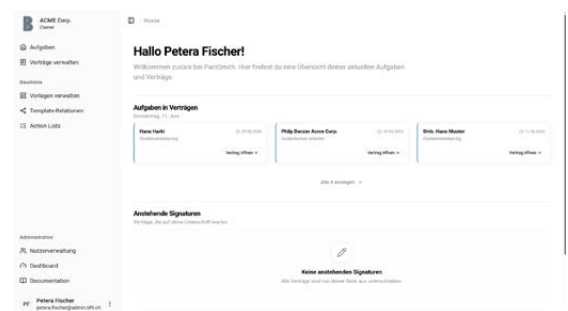
The system centres on a monolithic SvelteKit web application that interfaces with a PostgreSQL database and volume-based file storage. To enhance modularity and separate concerns, PDF generation is outsourced to a dedicated Python microservice. When legally required, QTSPs can be integrated via a modular interface. Currently, this is implemented via a certification container that enables seamless Switch-Sign integration and delivers eIDAS-compliant signatures. For streamlined hosting and deployment, the entire infrastructure is fully containerized and deployable via Docker Compose.

Conclusion

The culmination of this project is a fully functional, open-source platform that successfully transitions contract lifecycle tasks from fragmented manual processes to a unified digital ecosystem. The application is currently being introduced into the MSE-Office workflow.



High-level system architecture of the application



User dashboard displaying pending tasks that require the user's input

Planning Before Execution: Evaluating AI Agents on Natural Language Database Queries

Degree programme : Master of Science in Engineering
Specialisation : Computer Science
Thesis advisor : Prof. Dr. Ulrich Fiedler
Expert : Dr.-Ing. Andreas Walter

VIDEO



37

A vast amount of data is stored in relational databases, which typically require specialized knowledge to query. Text-to-SQL technology removes that barrier: a user asks a question in natural language, and an AI system translates it into the database code needed to answer it. This thesis explores a planning-first approach, where several AI agents agree on a plan before any code is written, letting the system reason like an analyst before generating SQL.

Objective

While Large Language Models (LLMs) show immense promise in Text-to-SQL translation, they frequently struggle with complex database schemas and multistep reasoning. This research aims to develop and evaluate advanced LLM-based systems that prioritize strategic planning before query execution. By focusing on planning-based multi-agent orchestration, the project seeks to significantly improve the functional accuracy and understandability of automated database queries. This approach brings reliable, self-service data access closer to the non-technical users who depend on it.

Methods

To address the limitations of standard LLM approaches, this research introduces PLATO (**PL**anning **A**gents for **T**ext-to-**S**QL **O**rchestration). Its core architecture uses a strict «plan-and-execute» split connected by a structured TaskPlan. This plan acts as the sole communication channel and carries the user's question, the expected shape of the answer,

and an ordered list of subtasks. Because the execution engine remains completely blind to which planner generated the task, any variance in the final output can be strictly isolated to the planning stage, ensuring rigorous experimental validity.

Solution

The results demonstrate a clear and substantial advantage to planning before execution. When tested on a demanding framework designed to mirror authentic enterprise applications, requiring models to navigate vast data environments and perform complex reasoning for multi-step queries, PLATO raised the share of correctly answered questions from 42 % to 63 % over a single-agent baseline. In doing so, it simultaneously reduced token usage, execution time, and overall cost by approximately half. Ultimately, this approach provides an effective and resource-efficient framework for natural language database queries, demonstrating the clear value of planning multi-agents in AI-driven data extraction.



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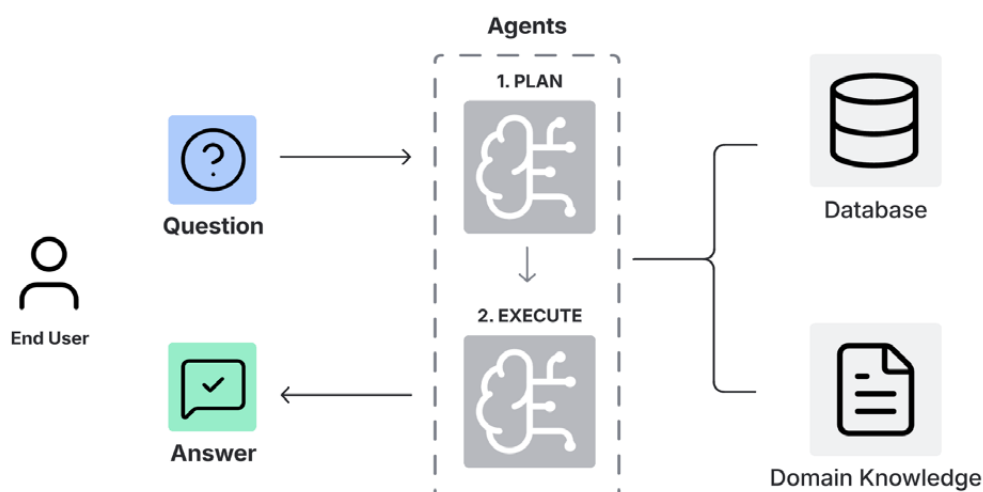


Figure 1: Text-to-SQL flow of an agentic plan-and-execute system.

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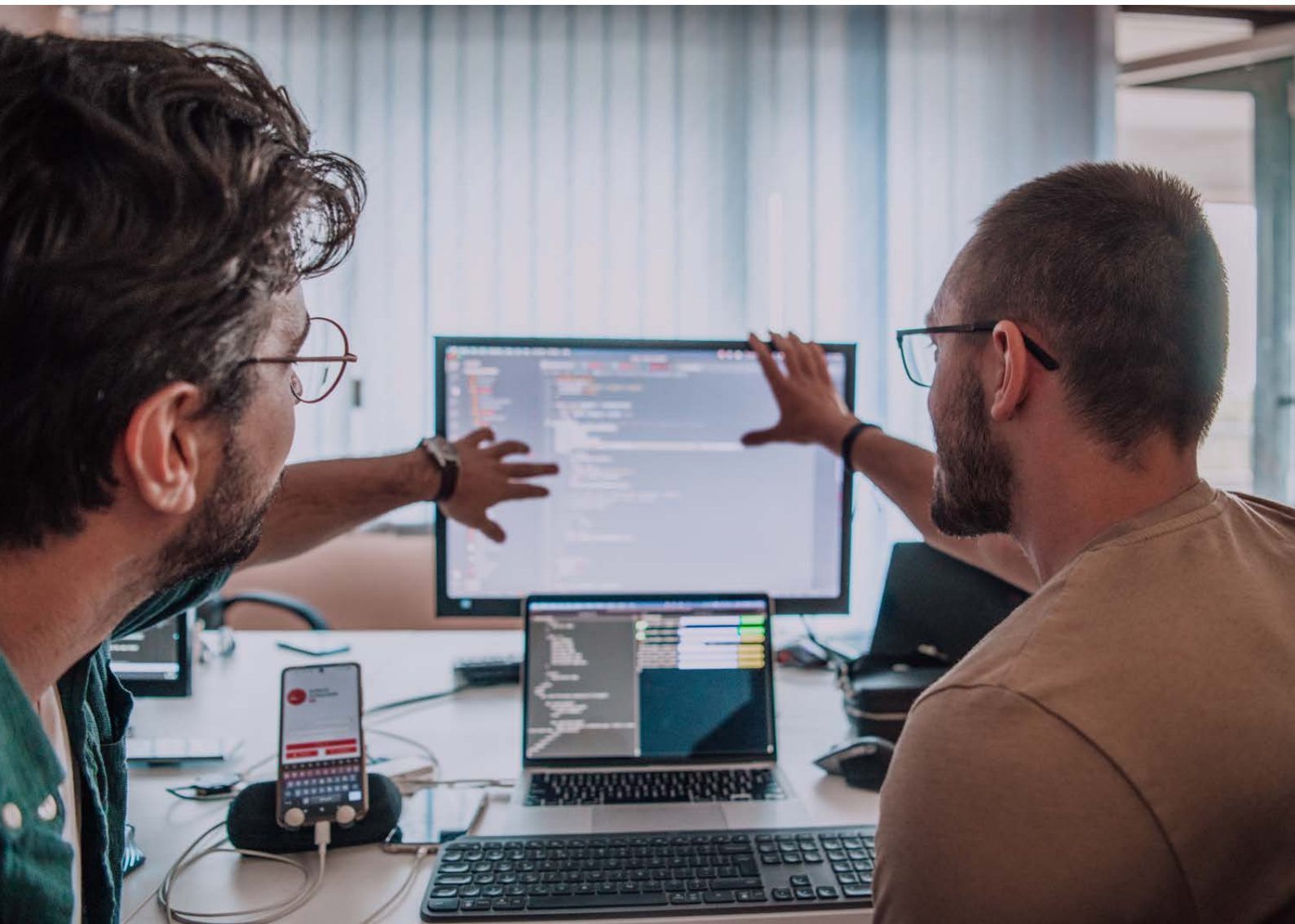
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