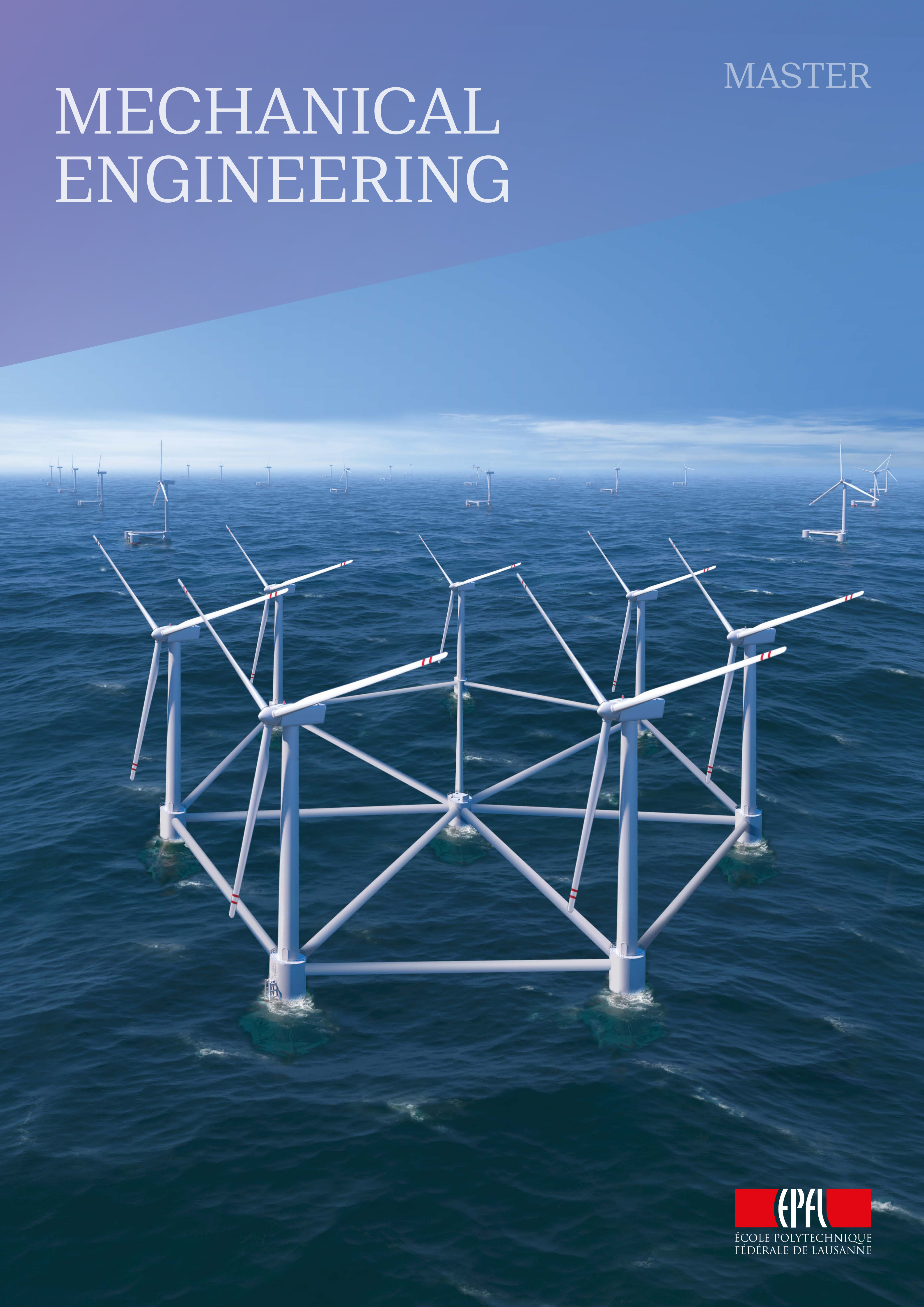
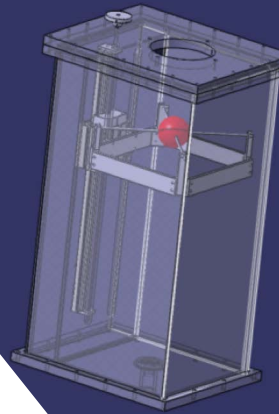
MASTER

MECHANICAL ENGINEERING



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Training in Mechanical Engineering is at the same time broad and very specialized. It includes solving both challenging problems, such as computing the fluid flow around an airplane or optimizing a hip prosthesis, and managing large multi-faceted projects, such as the design of an F1 car.



Influence of an obstacle on the vortex breakdown phenomenon

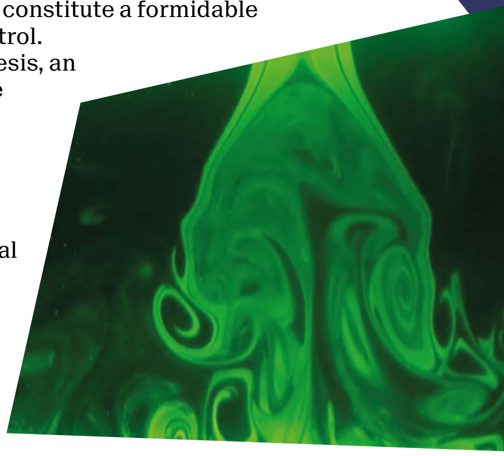
Vortex breakdown is a widespread phenomenon that affects a variety of flows involving vortices with axial flow, ranging from leading-edge vortices over delta wings to flame holders in combustion devices and Francis hydraulic turbines. It consists of an abrupt change in the flow topology when the swirl number S, which compares the magnitude of the azimuthal and axial velocity components, exceeds a critical value. The columnar solutions observed at low swirl (i.e., small rotational velocities) are characterized by large axial velocities and negligible axial gradients, whereas the breakdown solutions prevailing at large swirl (i.e., large rotational velocities) exhibit an internal stagnation point.

This Master's thesis is part of a larger project aiming at understanding the influence of downstream located obstacles onto the formation of vortex breakdown. Developing the ability, depending on the nature of the application, to trigger or suppress at will vortex breakdown through the addition of an appendix would still constitute a formidable breakthrough in the field of flow control.

During the four-month master's thesis, an experimental set-up allowing the investigation of a swirling jet impinging on a sphere was designed and realized. The position of the sphere can be varied externally, while the flow rate and the rotational velocity can be set independently. The first results show that vortex breakdown can be efficiently retarded by the presence of the sphere, opening the way to promising numerical and theoretical investigations of this surprising observation.

Voir la vidéo :

Romain Baud :
« J'aime bien l'idée de programmer à l'avance un comportement et le voir dans la réalité pour la fabrication, la production, la manipulation d'objet. »



Modelling of High-Pressure Die Casting of car doorframe

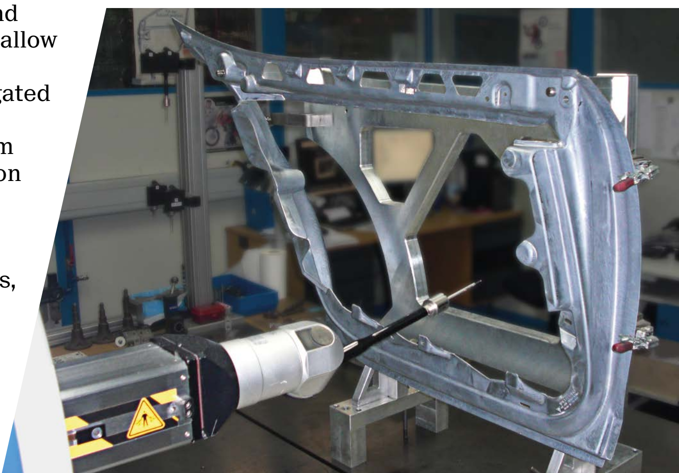
High-Pressure Die Casting (HPDC) is a manufacturing process that consists in the injection of molten metal alloys at high velocity into a mould cavity. It is often used by the automotive industry, typically for high-volume production of complex parts (gearbox and transmission housings, engine blocks, door frames) made from non-ferrous alloys such as Aluminium and Magnesium based alloys. Despite all its strengths, such as dimensional accuracy and high production rates, HPDC suffers from one major weakness: much 'trial and error' and reworking of the tooling is needed before obtaining products of the required quality.

This Master's thesis is part of a larger industrial project aiming at the development of a complete set of simulation tools for predicting the quality of parts, understanding the process and improving the design of new components. As such, these tools would allow minimizing the lead time and costs before production.

During the six-month Master's thesis, HPDC of a car doorframe was investigated by means of numerical simulations, whose results were validated by experimental measurements. The whole casting process was modelled, from the heating of the mould to the injection of the molten metal, its solidification and the extraction of the finished part, whose distortion was then experimentally assessed. The good agreement between numerical results and experimental measurements sets the cornerstone for the following of the project that includes the study of other phases of the production process, such as quenching and punching.

Bertrand Cardis:
"We are selling know-how. In all aspects of our job, we need to look for improvements; how can we do things better, stronger, lighter! Applying this know-how, we have been able to work on very exciting projects like Alinghi or Solar Impulse."

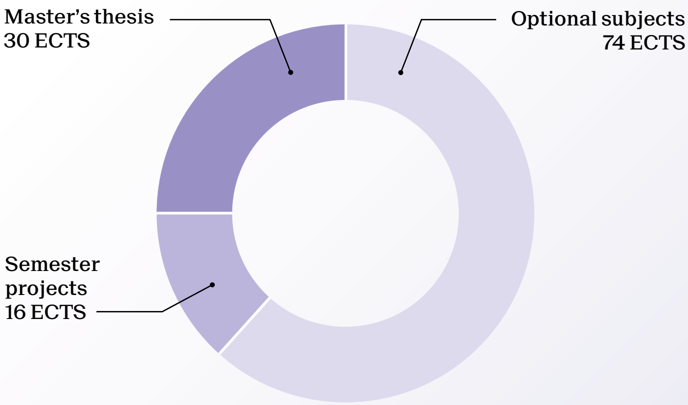
Watch the video:



Master of Science in

MECHANICAL ENGINEERING

2-year program - 120 ECTS



The program includes a compulsory industrial internship with a minimal duration of 8 weeks.

The program must be built around one of the following orientations:

A Aero-Hydrodynamics
B Control and Mechatronics
C Design and Production
D Energy
E Mechanics of Solids and Structures
F Biomechanics

Students can also choose a 30 ECTS Minor (incl. in the 120 ECTS credits):

- Biomedical Technologies
- Computational Science & Engineering
- Energy
- Materials Science
- Space Technologies
- Management, Technology and Entrepreneurship
- Science, Technology and Area Studies

	Orientation						Credits
Optional subjects	A	B	C	D	E	F	74
Advanced control systems		B	C	D	E	F	3
Advanced energetics				D			5
Advanced heat transfer				D			3
Aerodynamics	A			D	E		3
Aéroélasticité et intéraction fluide-structure	A			D	E		3
Applied mechanical design			C				4
Bases de la robotique		B	C				3
Biomechanics of the cardiovascular system	A				E	F	3
Biomechanics of the musculoskeletal system					E	F	5
Cavitation et phénomènes d'interface	A			D			3
Commande non linéaire		B	C		E	F	3
Composites polymères + TP					E		4
Computer-aided engineering			C				5
Conception mécanique intégrée			C		E	F	5
Dynamique numérique des solides et des structures	A		C		E	F	5
Engines and fuel cells	A			D			4
Fabrication assistée par ordinateur			C				5
Flow of dispersed media	A				E	F	3
Fracture mechanics			C		E	F	4
Hydraulic turbomachines	A			D			4
Hydrodynamics	A			D	E	F	5
Hydrodynamique acoustique	A			D		F	3
Instability	A						3
Introduction to nuclear engineering				D			2
Lifecycle performance of product systems			C	D			3
Mechanical product design and development			C				4
Mechanics of composites			C		E	F	5
Methods for rapid production and development			C				3
Modelling and optimization of energy systems				D			4
Model predictive control		B					3
Multi-body simulation		B	C		E	F	3
Numerical flow simulation	A			D		F	5
Numerical methods in biomechanics						F	3
Numerical methods in heat transfer	A			D			3
Particle-based methods	A				E	F	4
Production management			C				5
Project in mechanical engineering II							10
Renewable energy	A			D			4
Robotique industrielle et appliquée		B	C				2
Simulation and optimisation of industrial applications		B	C				4
Systèmes mécatroniques		B	C				5
System identification		B	C	D	E	F	3
Thermal power cycles and heat pump systems				D			2
Turbomachines thermiques	A			D			5
Turbulence	A						3
Two-phase flows and heat transfer	A			D			5

Semester projects							16
Project in mechanical engineering I							10
Project in human and social sciences							6

Career prospects

Due to the omnipresence of mechanical components in the objects that we use in our day-to-day lives, mechanical engineering training offers a great variety of future prospects. At the top of the list, we find the construction domain (including the car industry, shipbuilding, aeronautics or aerospace), but also the machine industry and energy conversion and management.
A large number of students decide to join large corporations and have the opportunity to specialize in the design of new products, at a production or even at a marketing level.
In that case, their role will consist in targeting new markets and advising customers. Other students will have the chance to combine all these tasks if they decide to join smaller entities, or if they choose to create their own structure, since the innovation spectrum in mechanical engineering is quite extended. Another important factor to underline is that the mechanical engineering training is world-recognized and allows students to plan a career abroad.

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