Nota 7

POSMEC

Programa de Pós-Graduação em Engenharia Mecânica

Graduate Program in Mechanical Engineering

Universidade Federal de Santa Catarina

November 2015

Presentation Outlook

1. History and Numbers
2. Academic Organization
3. Areas of Focus
4. Undergraduate-Master Integration
5. Closing Remarks

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POSMEC
Programa de Pós-Graduação em
Engenharia Mecânica

History and Numbers

History

First graduate program at UFSC

Graduted # Oct 2015

1981 PhD **379**

46 years of experience

1969 Master **1285**

1970 1980 1990 2000 2010 2020

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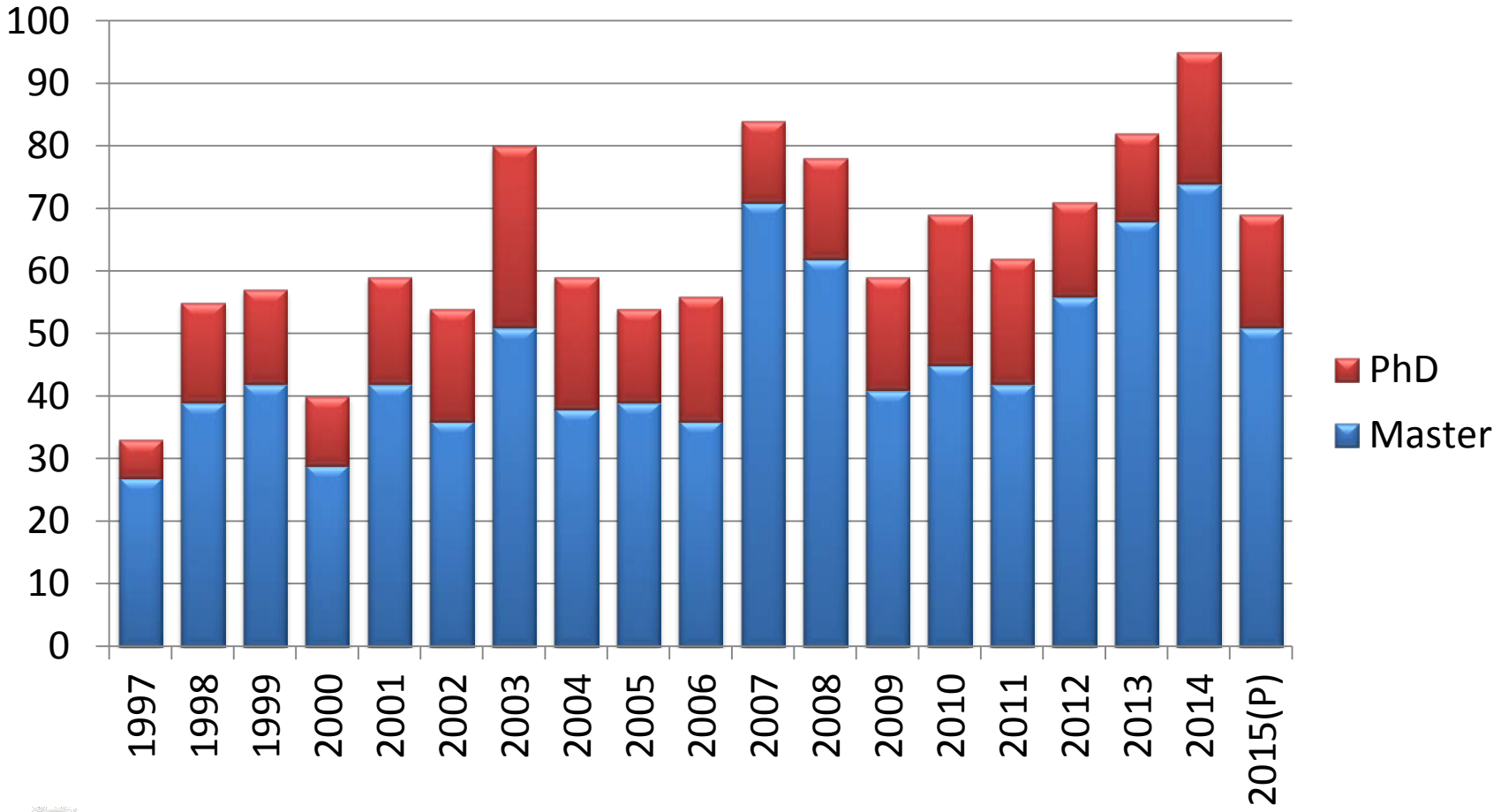
PhD and Master Thesis/year



(P) Partial until October 2015

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Current Numbers

- Professors
  - Permanent 44
  - Collaborators 14

  } 58
- Students
  - Master 184
  - PhD 124
  - Post-Docs 16

  } 324
- Staff 02
- **Total** **384**

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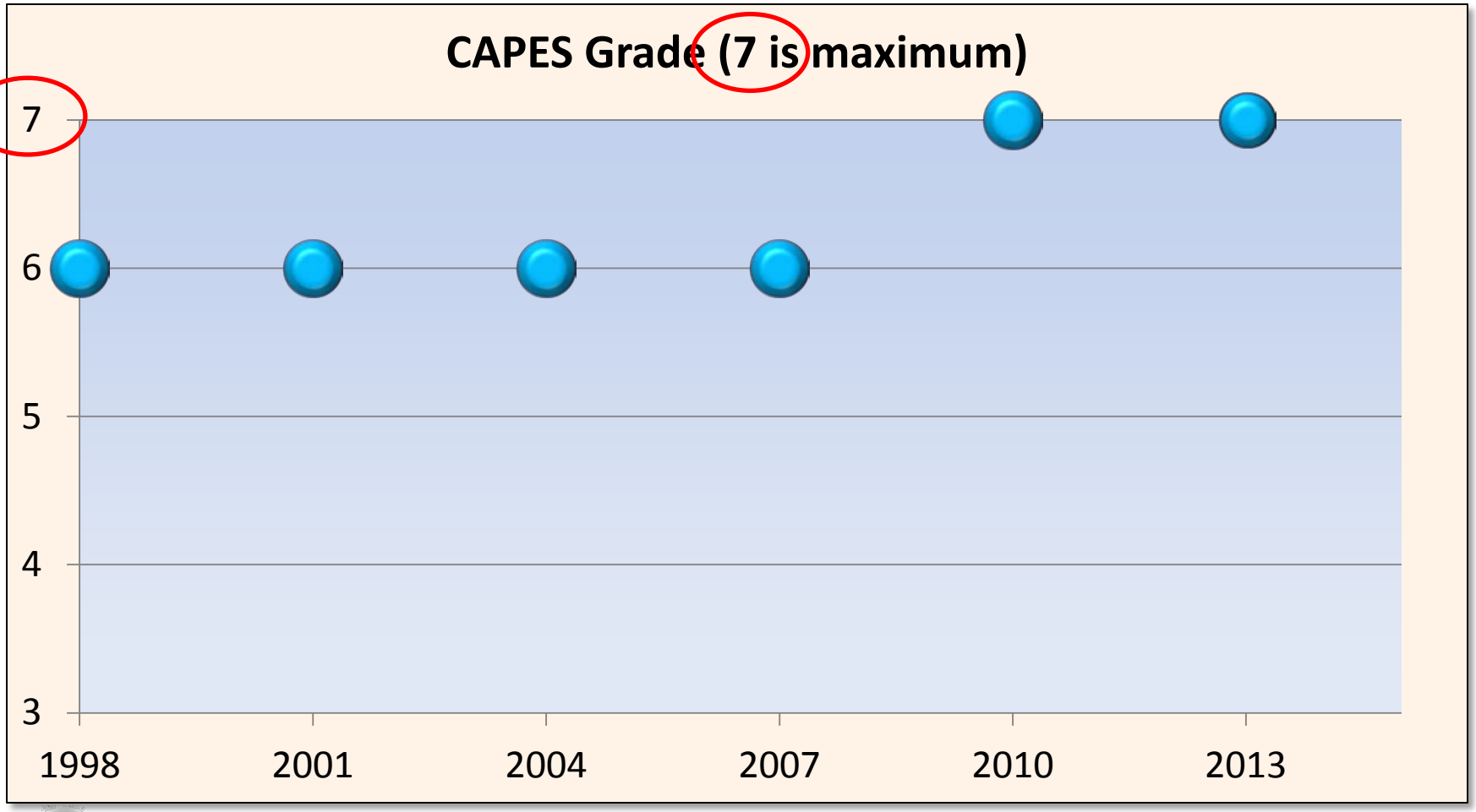
Academic Evaluation



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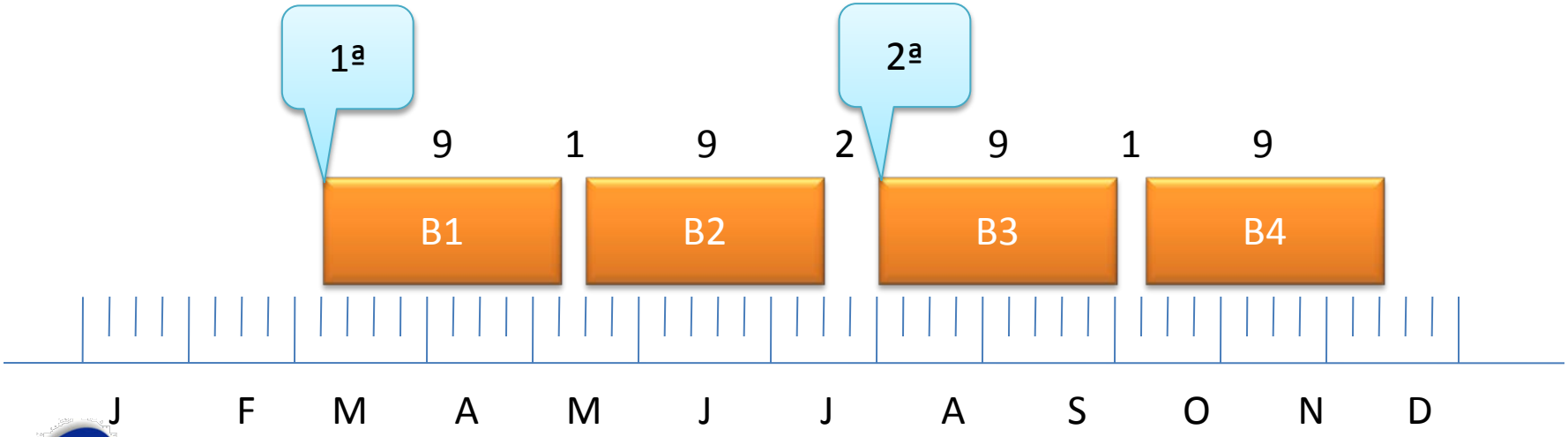
Programa de Pós-Graduação em Engenharia Mecânica

2

Academic Organization

Academic Terms

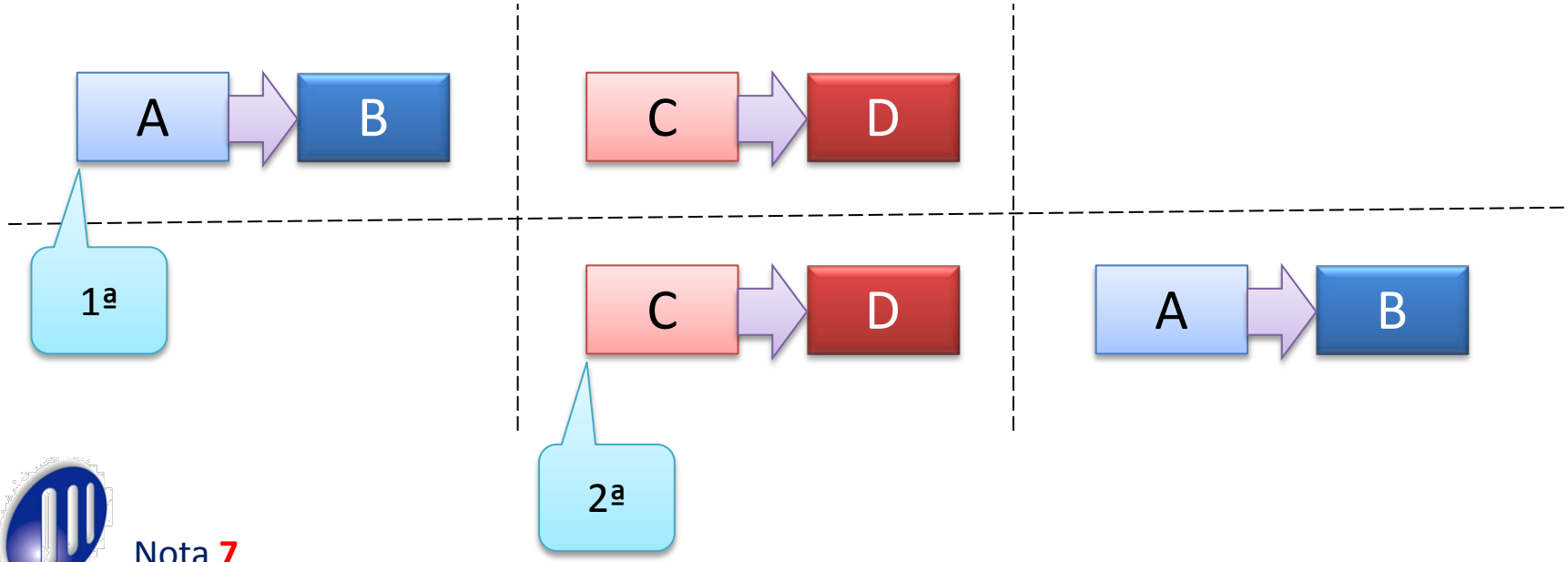
- Four academic terms/year:
  - 8+1* weeks
- Two entry points/year



* One extra week for holydays, travels and unexpected breaks.

Two entry points/year

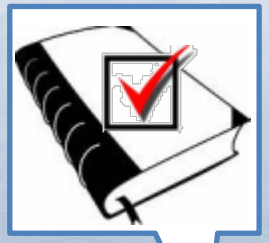
- Course sequencing reorganized to:
  - Eliminate or reduce dependencies.
  - Allow flexible sequencing.

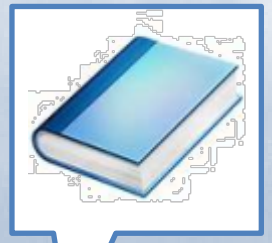


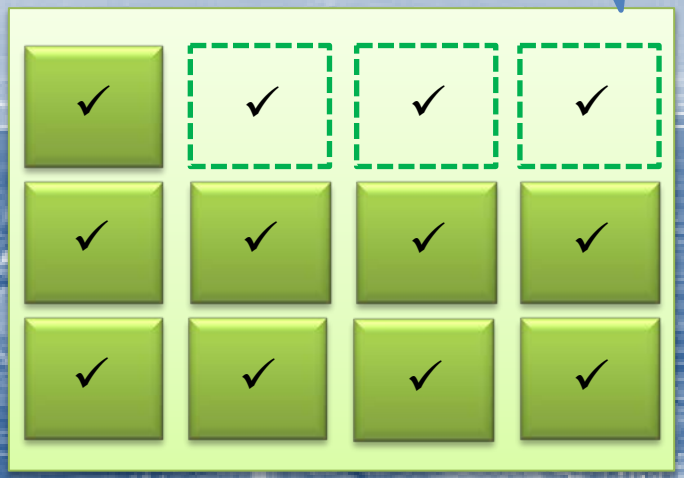
Course Credits

- One credit:
  - 15 class hours
- Master course
  - Minimum of 18 credits = 270 class hours
- PhD course
  - Minimum of 36 credits (18 + 18) = 540 class hours

Easy-flowing master







Thesis Development

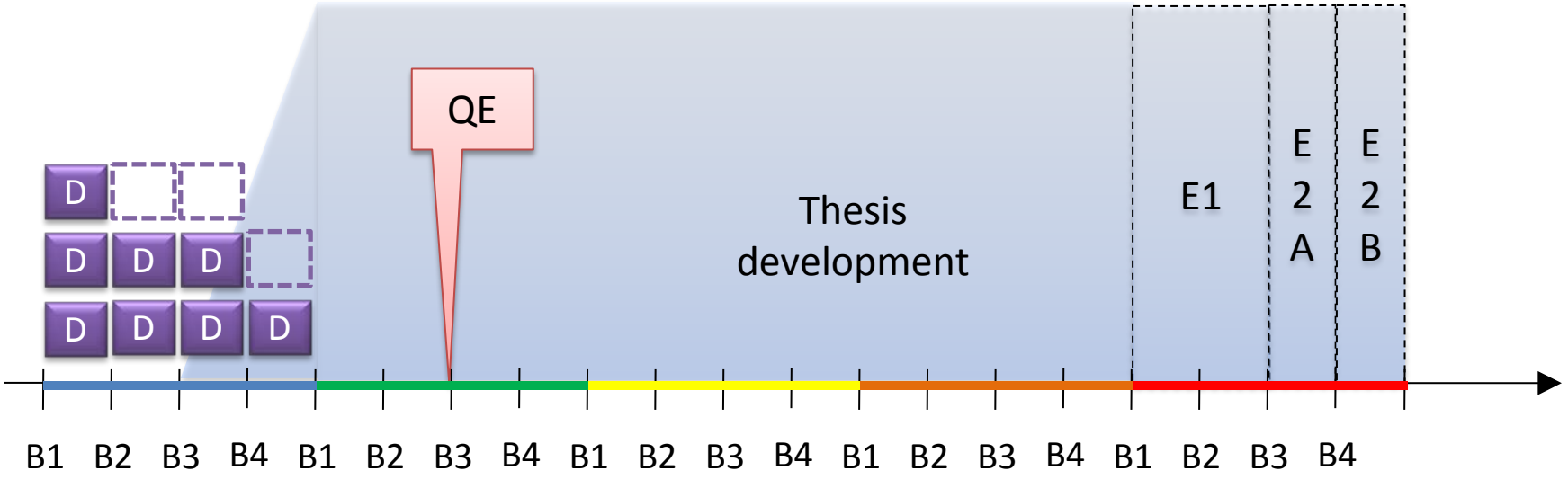
Year 1

Year 2

Scholarship

Regular PhD

18+18 course credits
12 credits for thesis
48 months deadline



D 1, 2 or 3 credit courses

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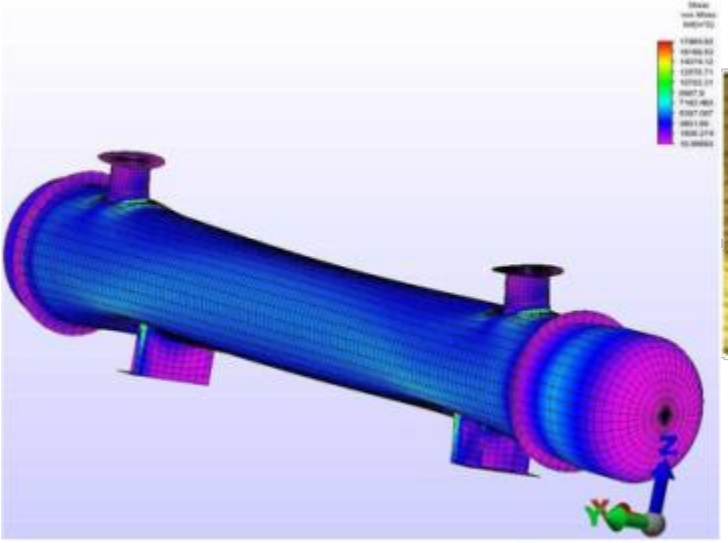
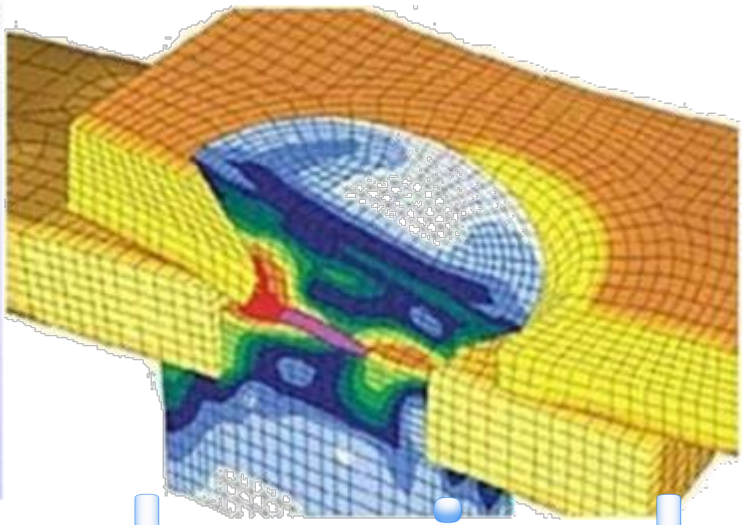
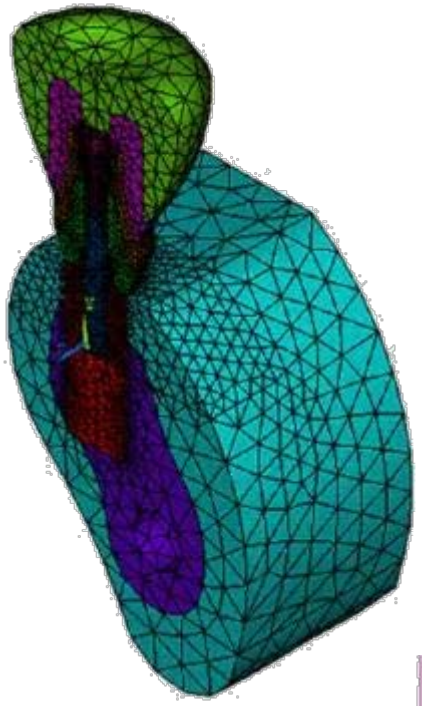
3

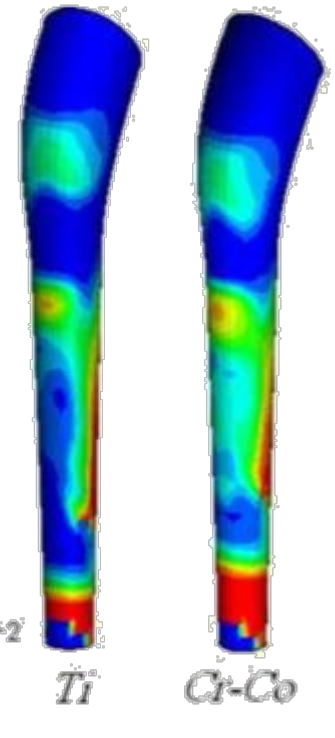
Areas of Focus

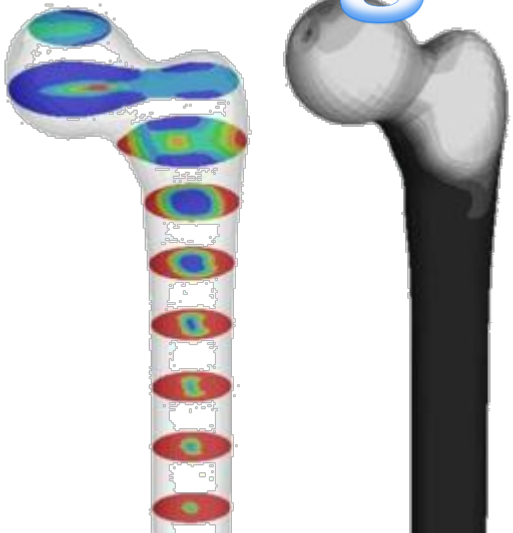


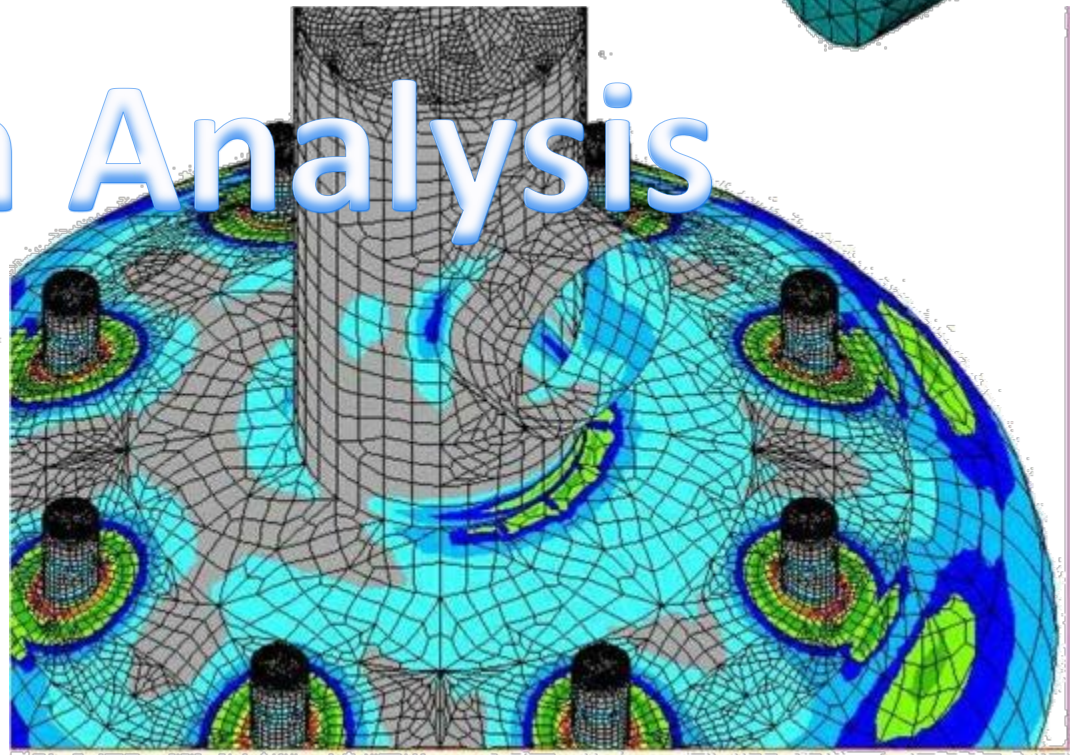




Mechanical Design Analysis





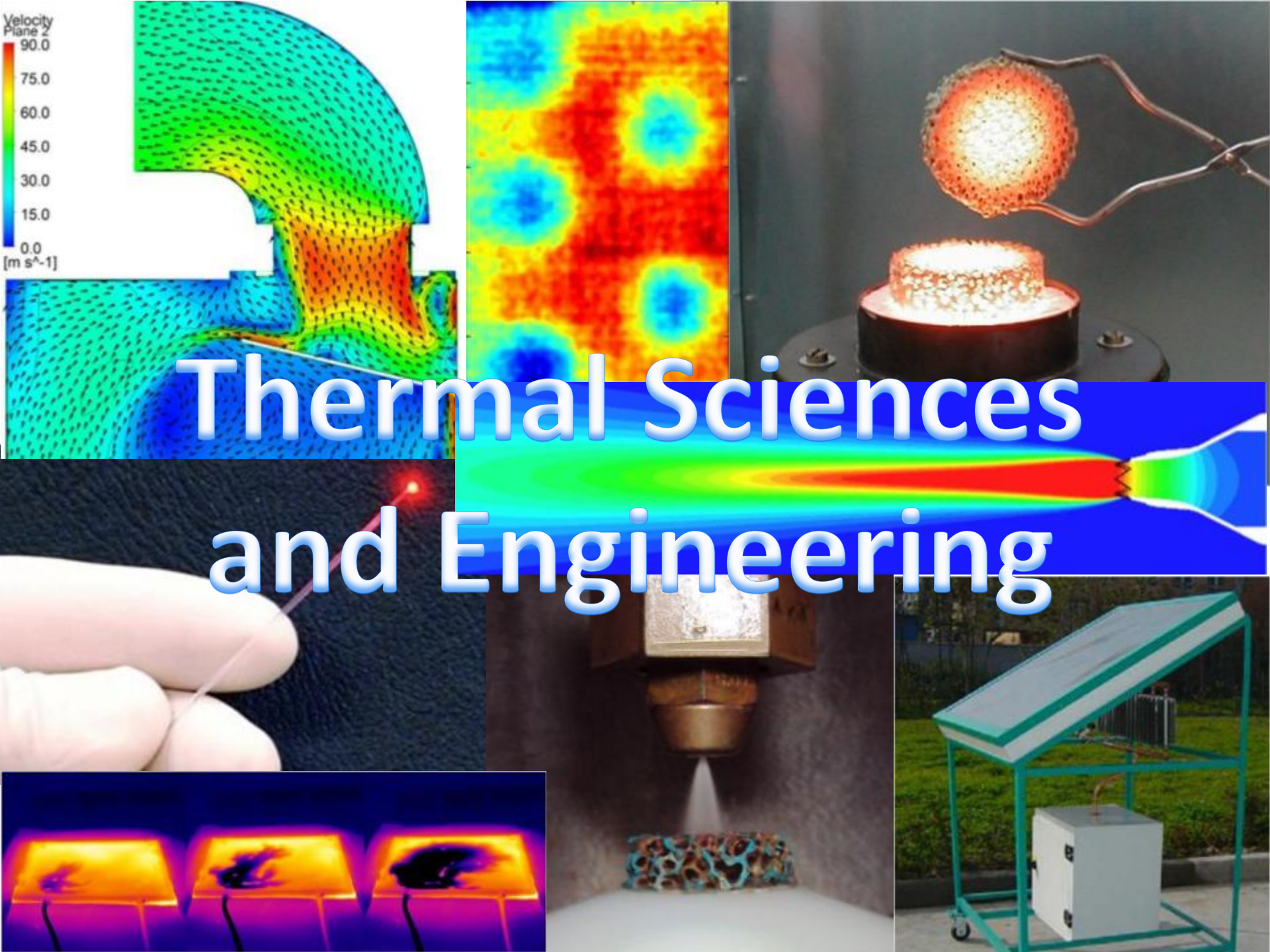


Mechanical Design Analysis

- Research topics
  - Computational solid mechanics
  - Finite element method
  - Design optimization
  - Biomechanics
  - Composite materials
  - Fracture mechanics and fatigue
  - Damage mechanics
  - Structure reliability
  - Structure dynamics

Mechanical Design Analysis

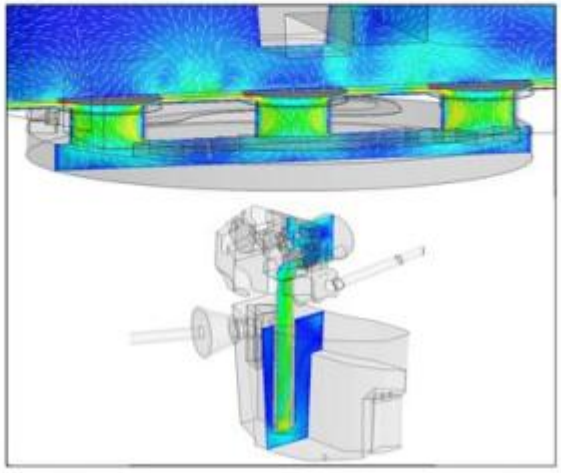
- Five professors
- Two labs
  - Biomechanics
  - Stress analysis


Velocity
Plane 2
90.0
75.0
60.0
45.0
30.0
15.0
0.0
[m s^-1]
Thermal Sciences
and Engineering

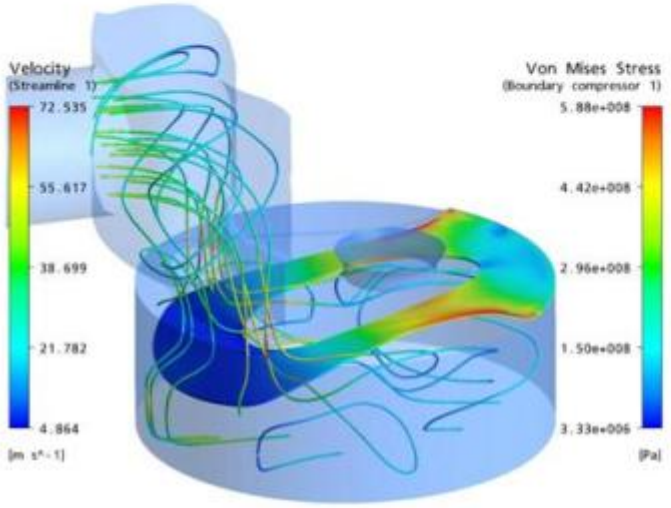
Thermal Sciences and Engineering

- Research topics
  - Energetic analysis
  - Thermal analysis of buildings
  - Characterization of oil-reservoir rock
  - Combustion
  - Air conditioning
  - Thermal control of satellites
  - Boiling and condensation
  - Solar energy
  - Flow and thermodynamics of mixtures
  - Fluid flow in porous media
  - Power generation and cogeneration
  - Instrumentation for thermal analysis of buildings
  - Lubrication
  - Computational fluid mechanics and heat transfer
  - Discrete models of fluid flow (Lattice-Gas)
  - Radiation
  - refrigeration
  - rheology
  - Simulation of oil reservoirs
  - Heat pipes
  - Turbulence

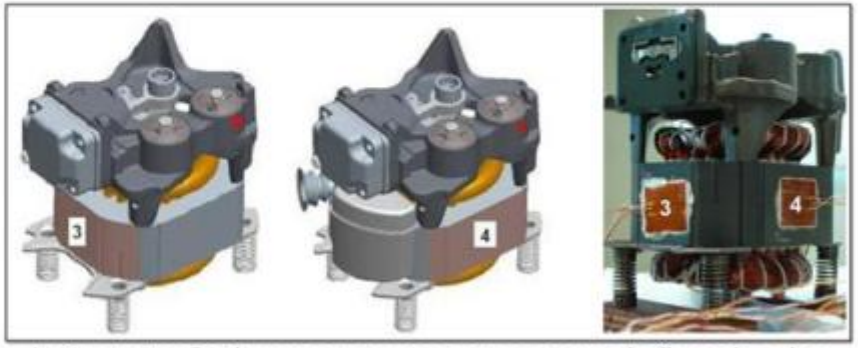
Título da atividade ou projeto de pesquisa: Mecânica dos fluidos e termodinâmica de compressores
Nome da linha de pesquisa na qual se insere: Refrigeração
Objetivos da atividade ou projeto de pesquisa: Desenvolvimento de compressores inovadores de alta eficiência
Entidade financiadora: Embraco / BNDS / CNPQ / FAPESC / CAPES



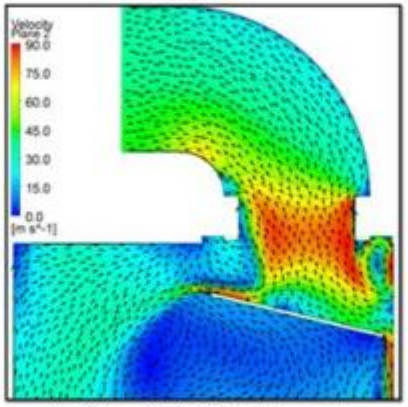
Análise do escoamento em um sistema de descarga com múltiplos orifícios



Interação fluido-estrutura

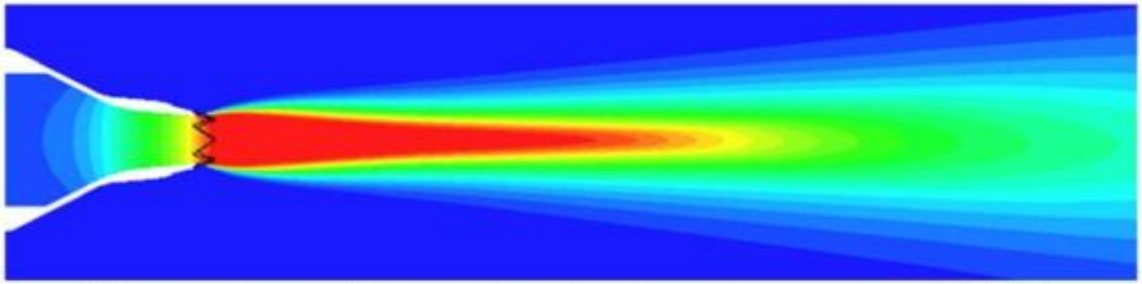


Instrumentação de um compressor com sensores de fluxo de calor.

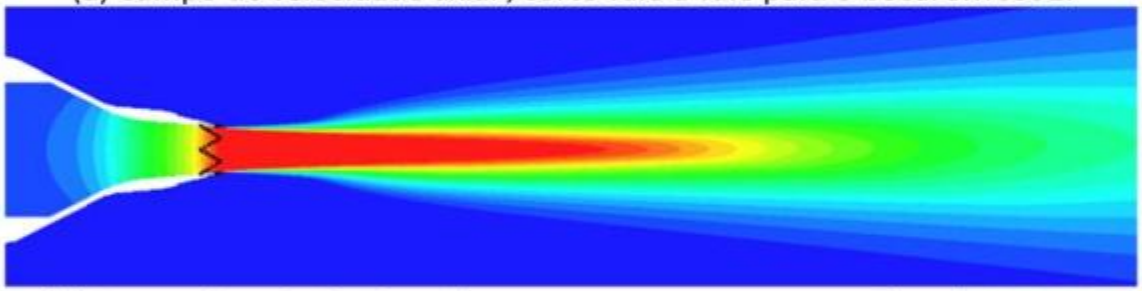


Análise CFD 3D utilizando *software* ANSYS CFX.

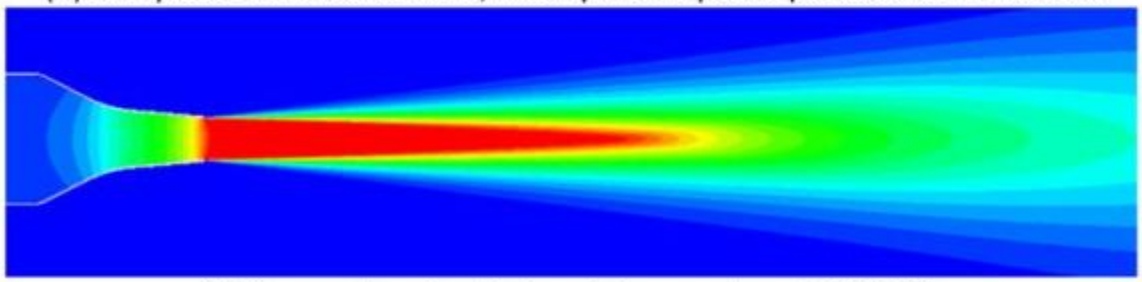
Título da atividade ou projeto de pesquisa: Análise e controle de ruído acústico gerado por escoamentos turbulentos
Nome da linha de pesquisa na qual se insere: Turbulência
Objetivos da atividade ou projeto de pesquisa: Redução do ruído acústico gerado por aviões
Entidade financiadora: Embraer / FINEP / CNPQ / CAPES



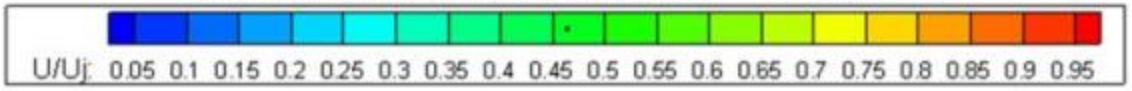
(a) Campo de velocidade axial , corte vale a vale para o bocal SMC001.

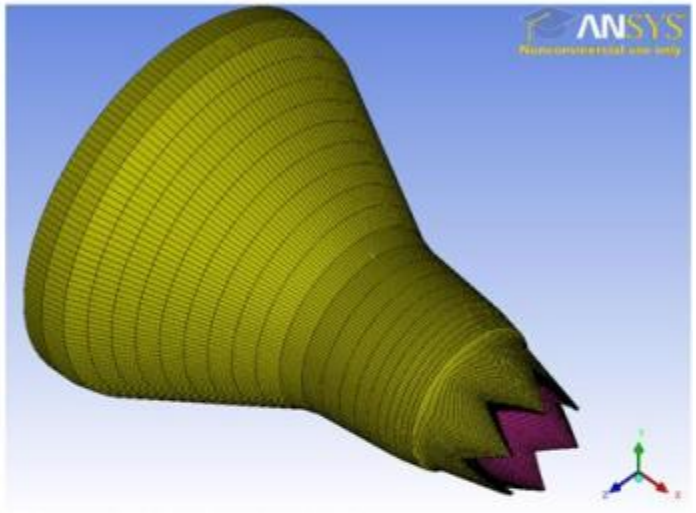


(b) Campo de velocidade axial , corte ponta a ponta para o bocal SMC001.



(c) Campo de velocidade axial para o bocal SMC000.

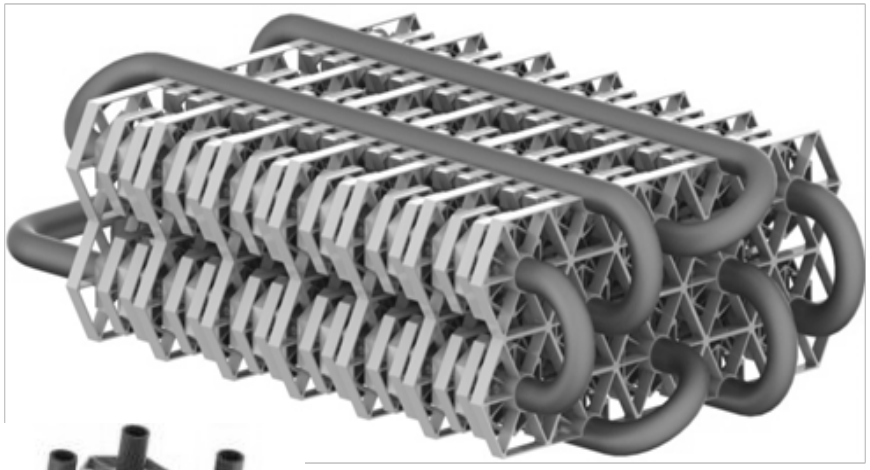




Malha do bocal simulado

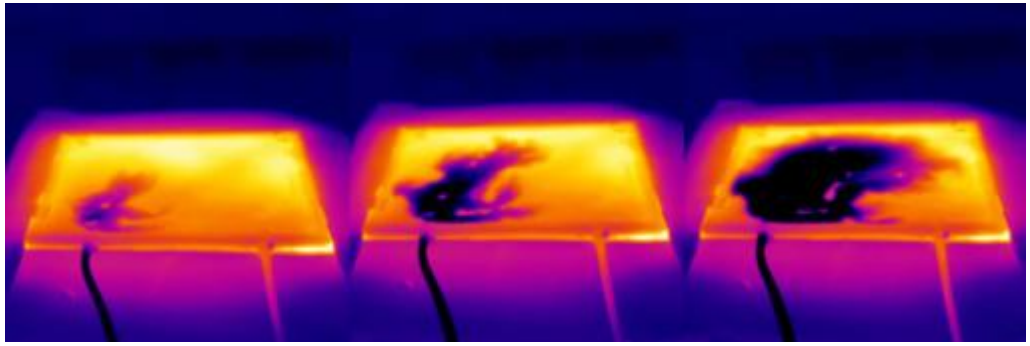
Bocais analisados

Título: Novos conceitos em trocadores de calor compactos
Linha de Pesquisa: Refrigeração
Objetivo: Avaliar experimentalmente e por meio de modelos matemáticos o desempenho termo-hidráulico de novos conceitos e geometrias de trocadores de calor compactos
Entidade financiadora: CNPq, FINEP e Embraco



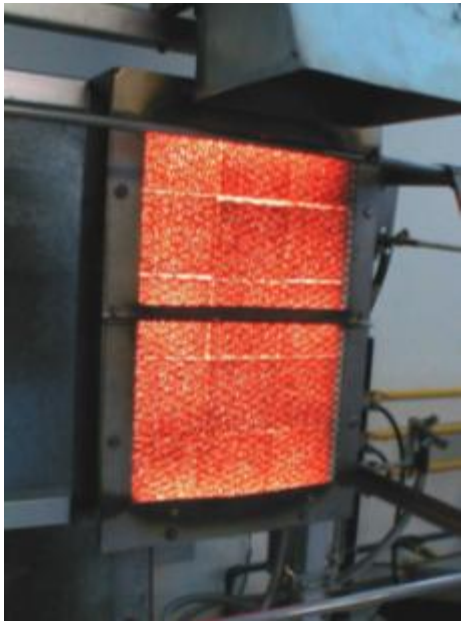
Evaporador de microcanais em espiral

Evaporador de aletas periféricas (cooperação com a University of Michigan – Prof. M. Kaviany)

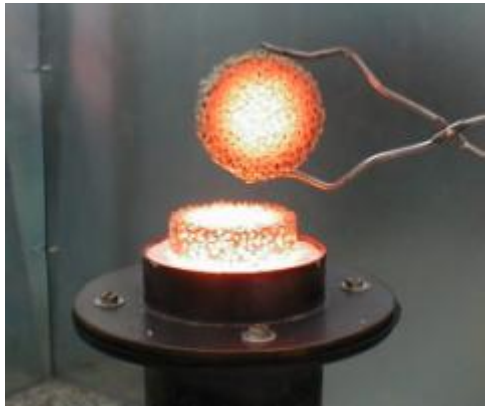


Mapa termográfico de um trocador de calor de matriz porosa flexível

Development of Porous Burners

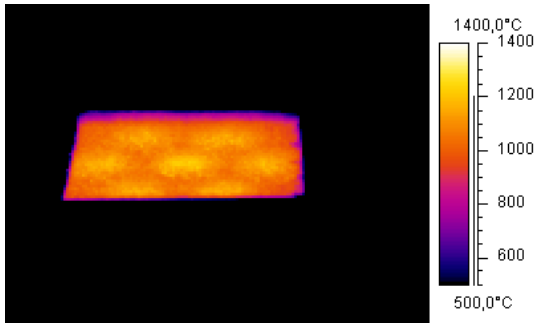


75 cm



Queimador Poroso Radiante

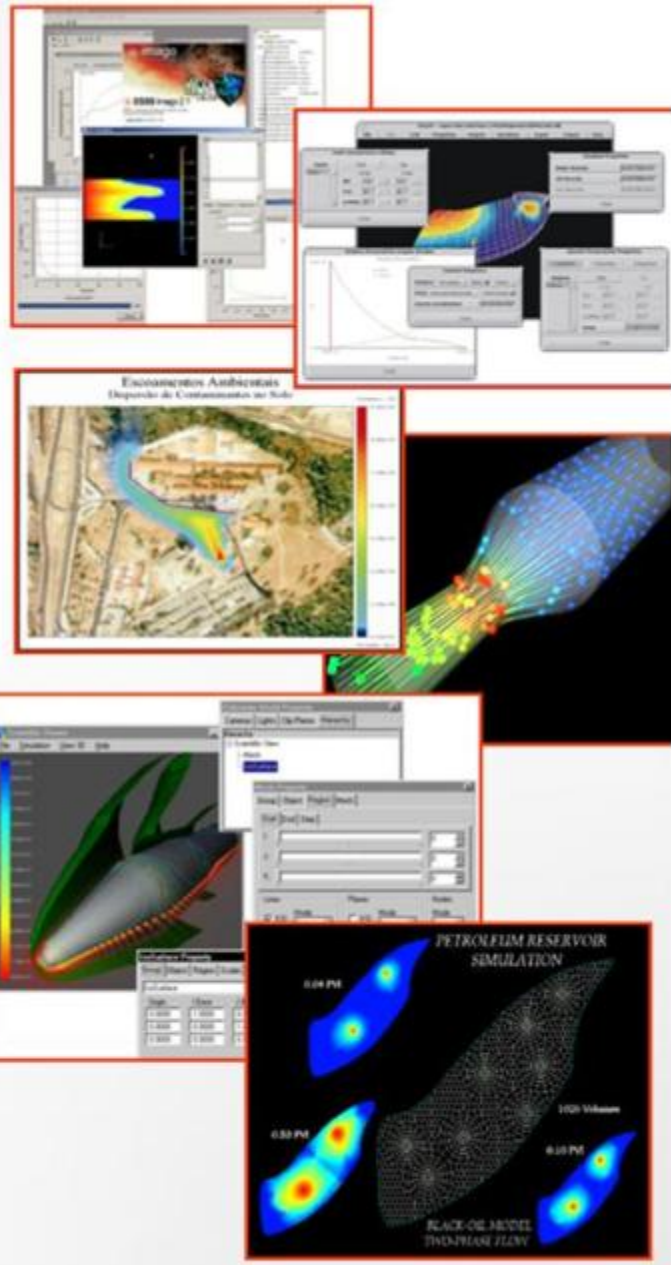
Painel radiante feito de esponjas cerâmicas de carbeto de silício de 10 e 30 ppi com área superficial de 0,13 m².



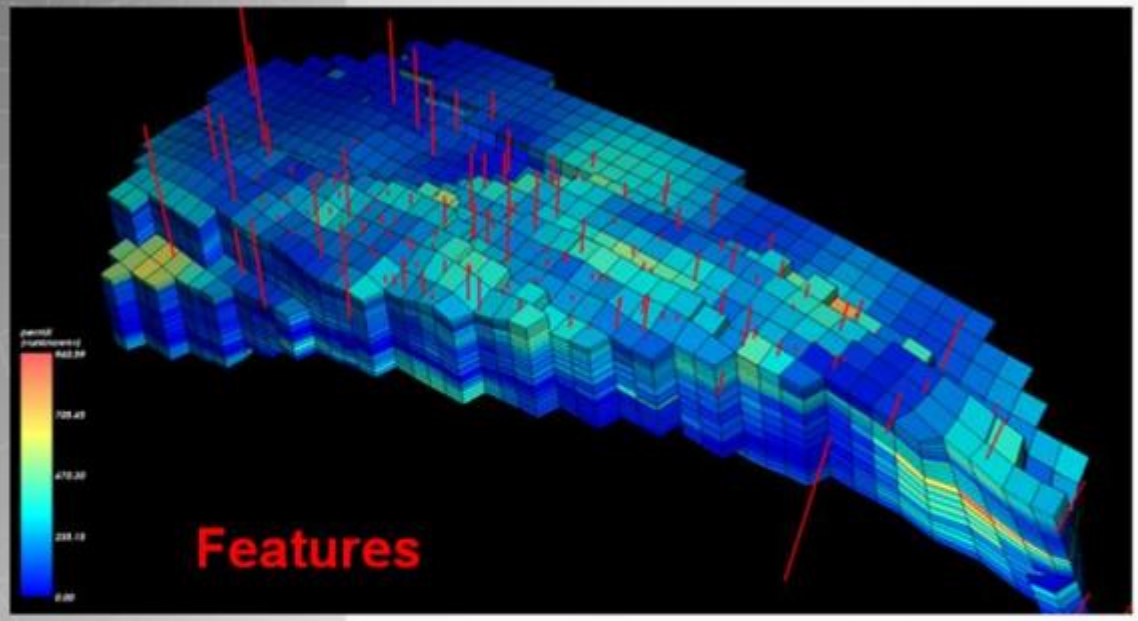
1. Pereira, F. M., Oliveira, A. A. M. e Fachini, F. F., Special Topics and Reviews in Porous Media, vol. 2, issue 2, 2011
2. Francisco, R. W. ; Rua, F. ; Costa, M. ; Catapan, R. C. ; Oliveira, A. A. M. . Energy & Fuels, p. 100104083714022, 2009.
3. Pereira, F. M. ; Oliveira, A. A. M. ; Fachini, F. F. . Journal of Fluid Mechanics, v. 657, p. 285-307, 2010.
4. Catapan, R. C.; Oliveira jr., A. A. M. ; Costa, M. Experimental Thermal and Fluid Science, v. 35, p. 172-179, 2010.
5. Pereira, F ; Oliveira, A ; Fachini, F . Combustion and Flame, v. 156, p. 152-165, 2009.

Atividades de Pesquisa Aplicada

- Simulação de reservatórios de petróleo
  - Desenvolvimento de algoritmos e bibliotecas;
  - Desenvolvimento de simuladores;
  - Simulação Poço/Reservatório;
- Escoamentos multifásicos
  - Escoamentos de bolhas em e gotas em liquidos;
  - Determinação das forças de interface;
- Escoamentos siderúrgicos
  - Escoamento de metais líquidos no canal de alto forno, remoção de escória, processos RH, processos KR;
- Aerodinâmica sub e supersônica
  - Esquemas para qualquer velocidade
  - Crescimento de gelo em aeronaves



Rede de Tecnologia de Poços
Projeto Poço-Reservatório



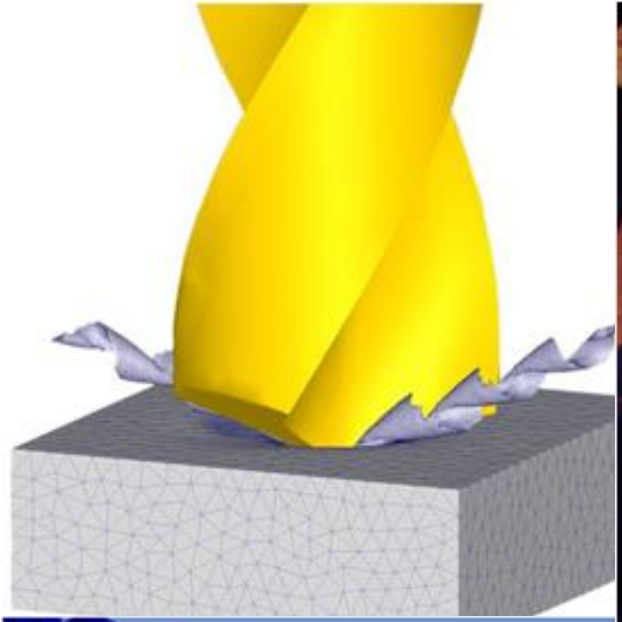
Reservoir

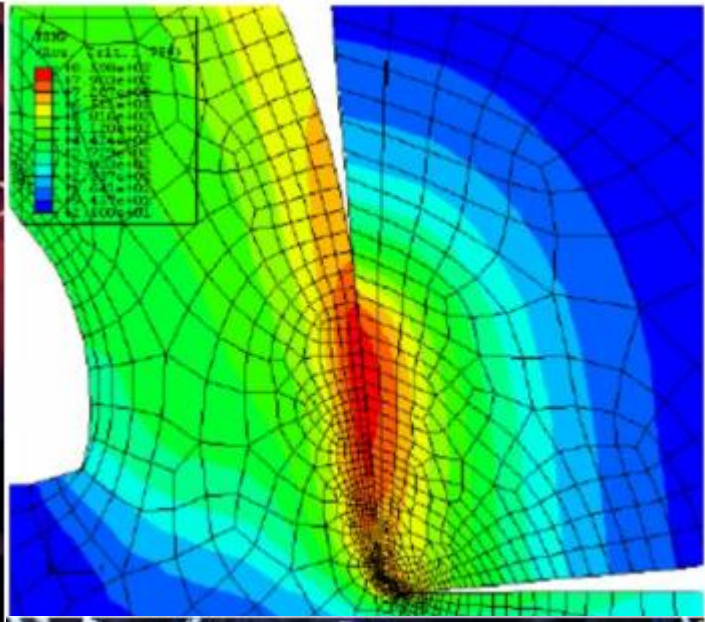
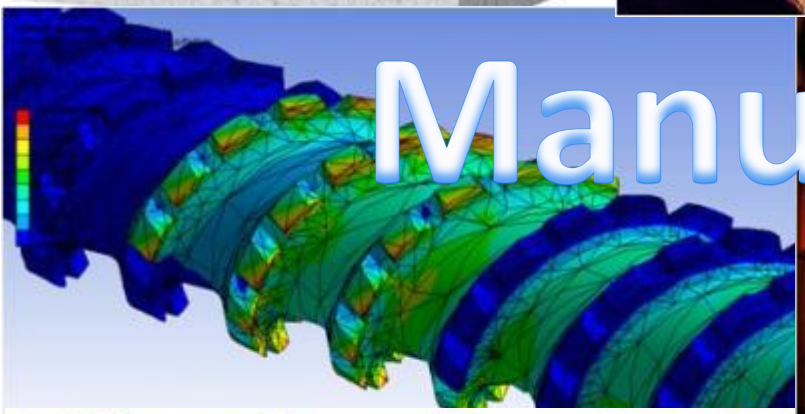
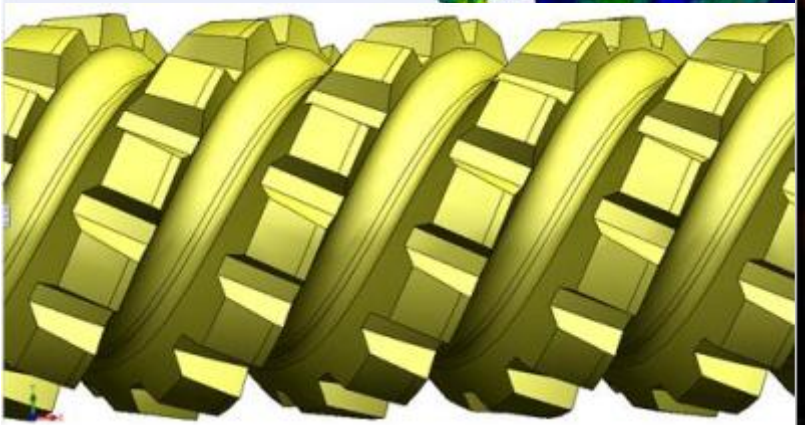
- Three dimensional
- Standard black-oil
- Capillary pressure
- Rock/fluid compressibility
- Heterogeneous and anisotropic medium
- Fully implicit solution method
- Corner-point grids (NNC, pinch-out, LGR)

- **Well**
  - One dimensional drift flux model
- **Coupling**
  - Well model based on a 3D semi-analytical solution using Green's function
  - Consideration of completion effects (Inflow Control Device, perforation, fractured reservoir, etc)

Thermal Sciences and Engineering

- 18 professor
- Six laboratories
  - Combustion and Thermal System Engineering
  - Solar Energy and the Satellite Thermal Control
  - Thermal Sciences
  - Porous Media and Thermophysical Properties
  - Numerical Simulation of Fluid Mechanics and Heat Transfer
  - Thermophisics and Refrigeration



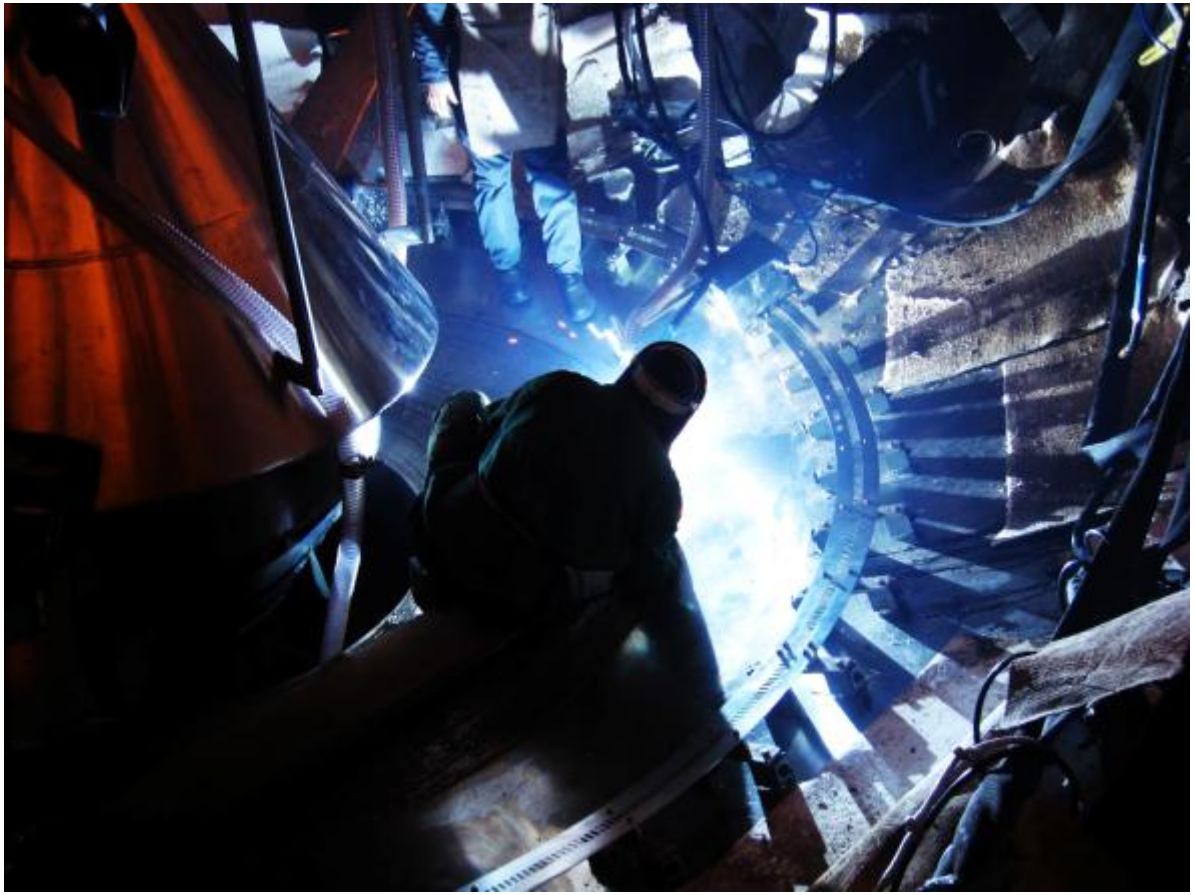





Manufacturing

Manufacturing

- Research topics
  - Welding
  - Welding equipment
  - High temperature brazing
  - Quality Engineering
  - Precision machining
  - Analysis of machined surfaces
  - Machine automation
  - CNC- operated machines and tools
  - Dynamic testing of machines and instruments
  - Design and manufacture of plastic components
  - Rapid prototyping
  - Tools management and machining database
  - Computer-aided process planning
  - Product computational modeling
  - Design for manufacturing
  - Machining processes

Aplicação de tecnologia PTA-P em Regiões de Turbinas Hidráulicas Sujeitas à Erosão por Cavitação



Sistema de deslocamento de tocha Tartílope V2F em uso na indústria

Modeling and Simulation of Broaching process

Research line:

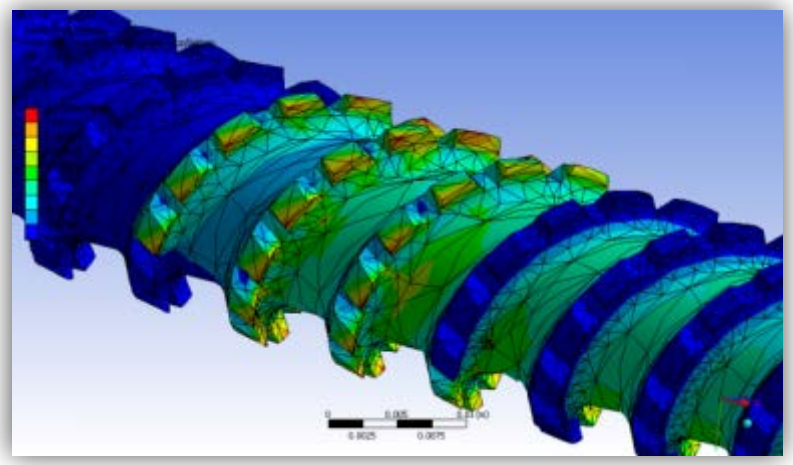
Modeling and Simulation of Machining

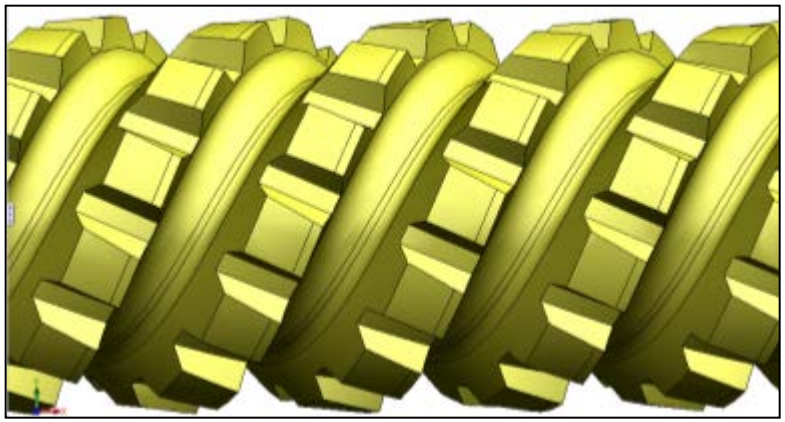
Objectives:

Process and broaches geometry optimization and machining forces and stress distribution analysis during machining.

Financing:

CNPq, partner companies.





Ultraprecision machining

Research line:

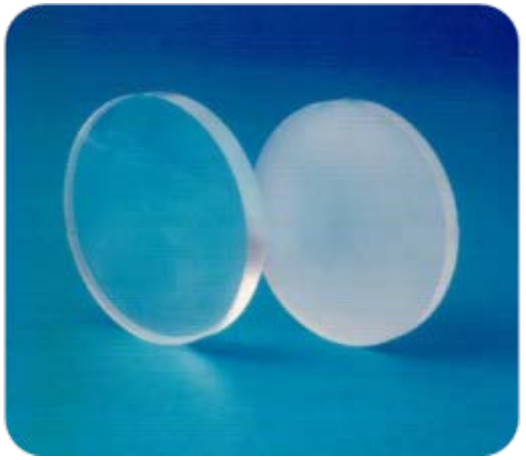
Defined geometry tools machining

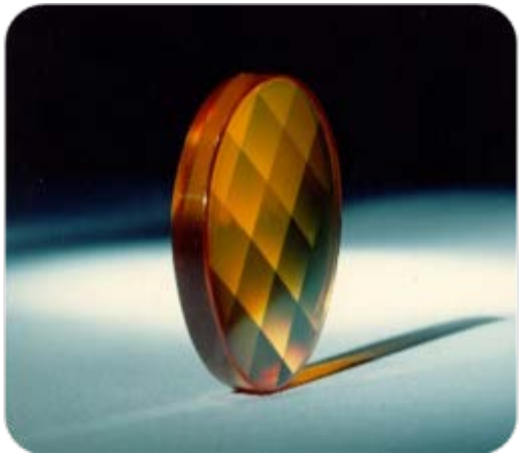
Objectives:

Extreme surface quality production for the manufacture of reflective and transmissive optical surfaces as well as mechanical elements of high dimensional, shape and surface finishing accuracy.

Financing:

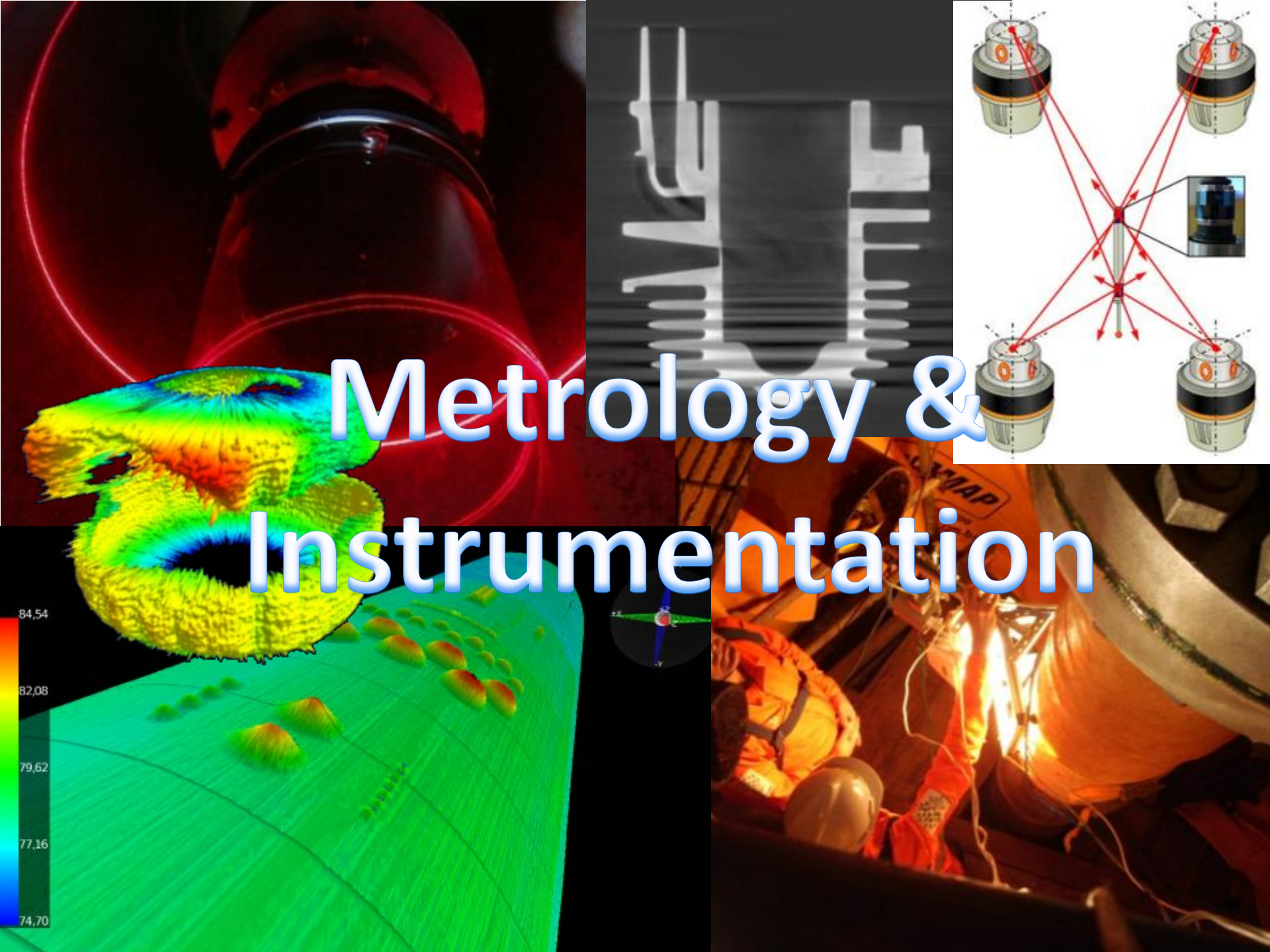
Partner companies.





Manufacturing

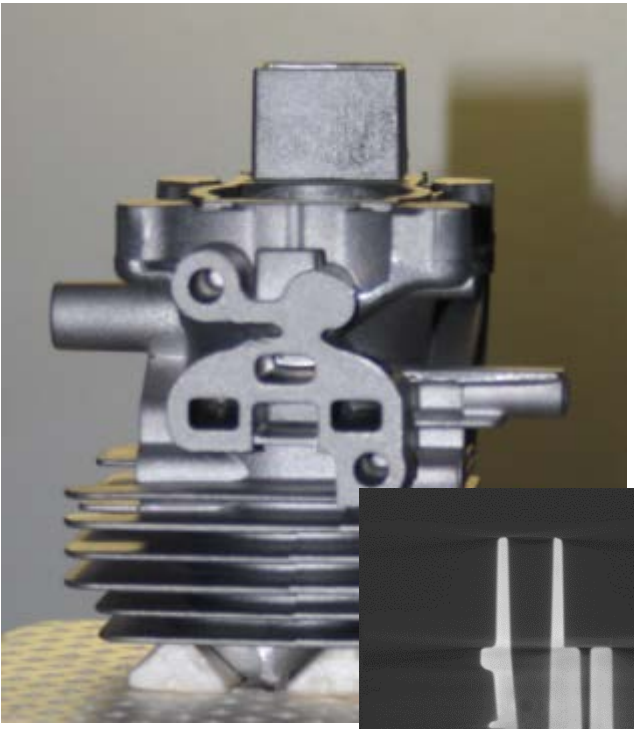
- Ten professors
- Seven labs
  - Plastic injection
  - Numerical control (CNC) and industrial automation
  - Forging
  - Welding
  - Automation hardware
  - Precision mechanics
  - Machining

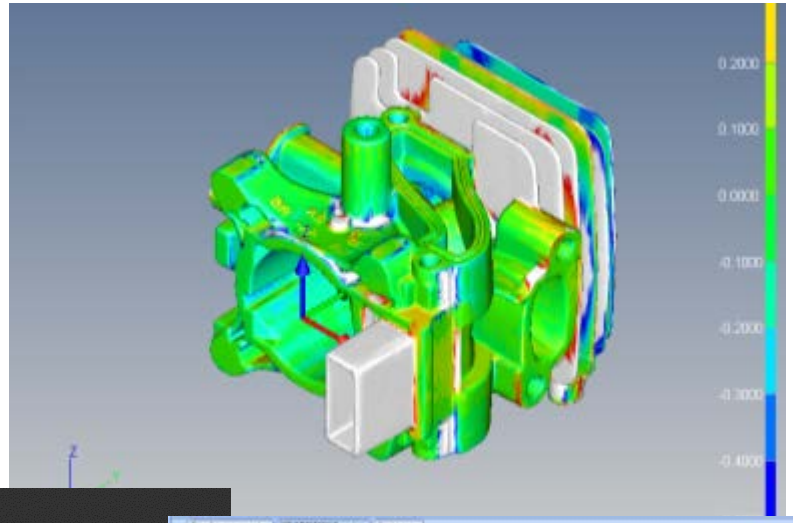

Metrology &
Instrumentation
84,54
82,08
79,62
77,16
74,70

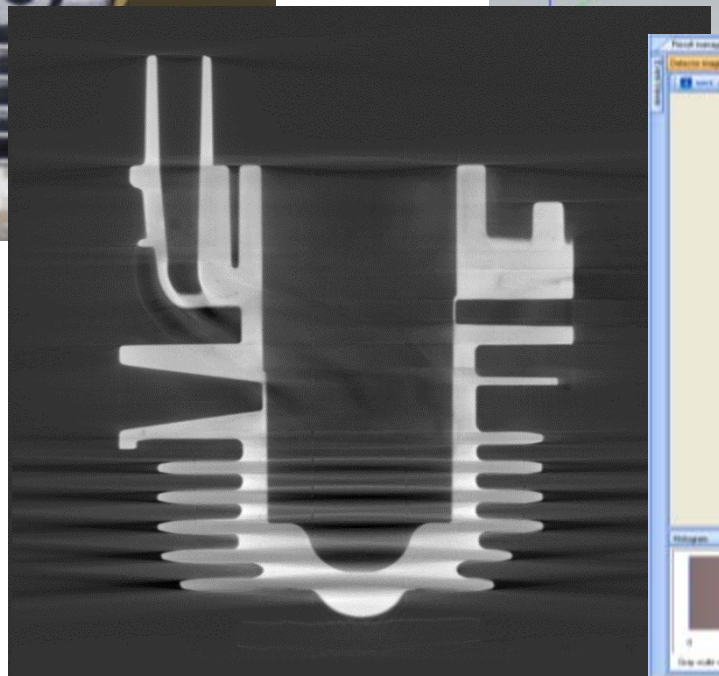
Metrology & Instrumentation

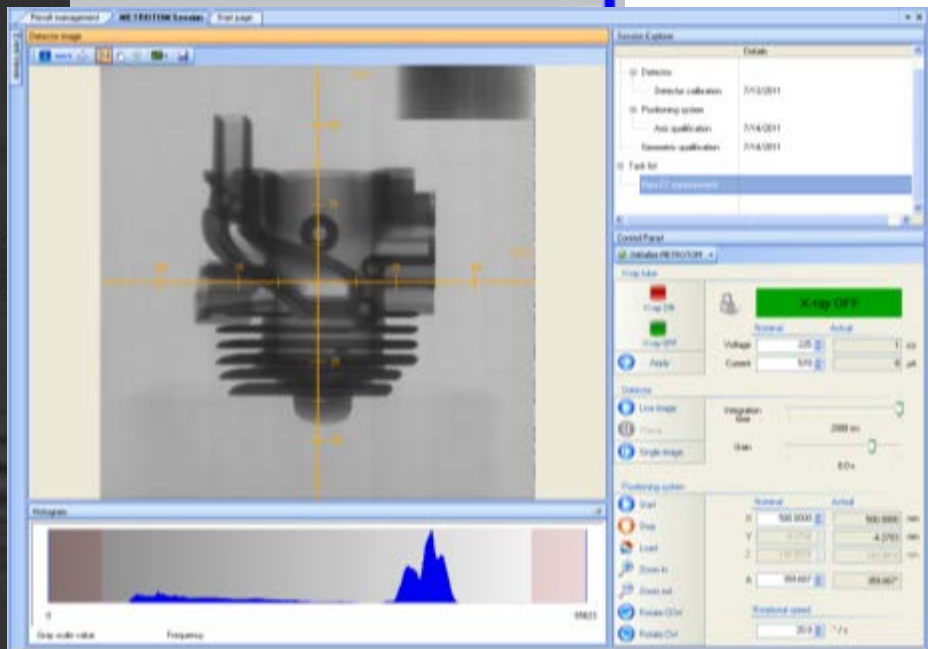
- Research topics
  - Industrial testing systems
  - Industrial tomography
  - Optical methods for measurement and inspection
  - Machine vision applications

3D shape measurement with industrial computer tomography

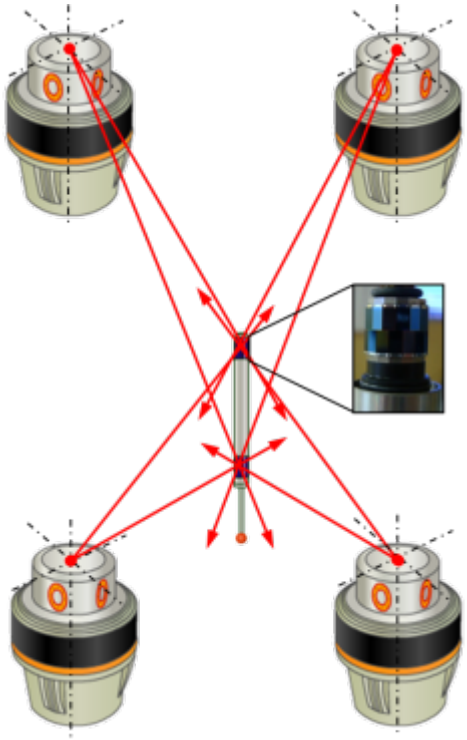




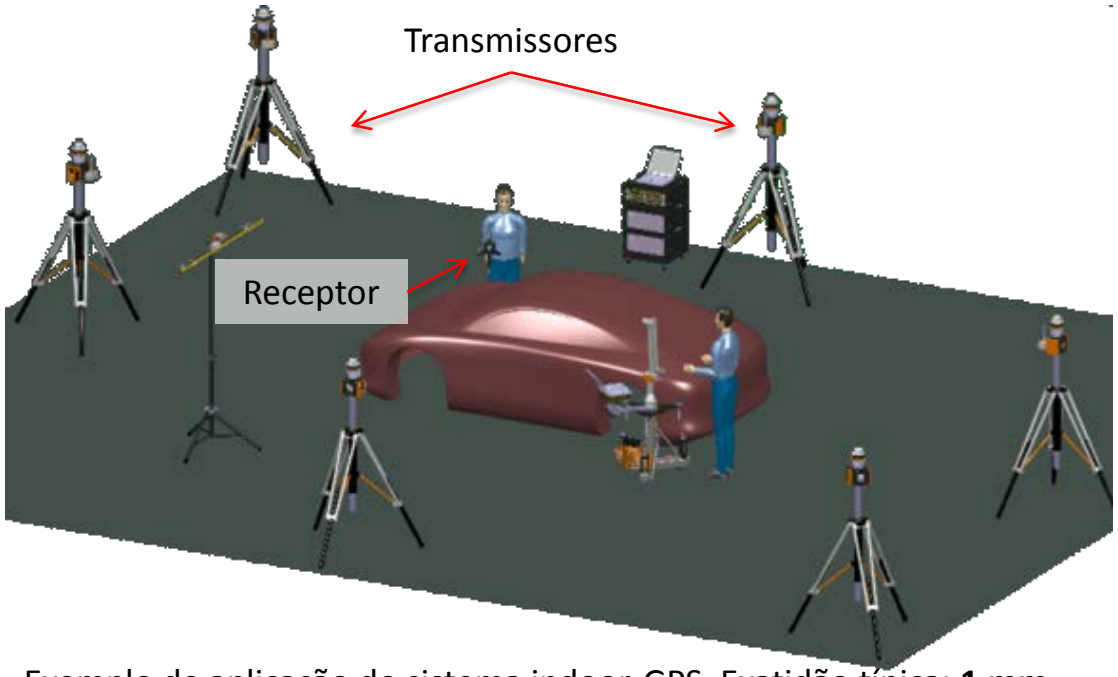




Large parts measurement with industrial geodesy



Sistema **indoor-GPS**

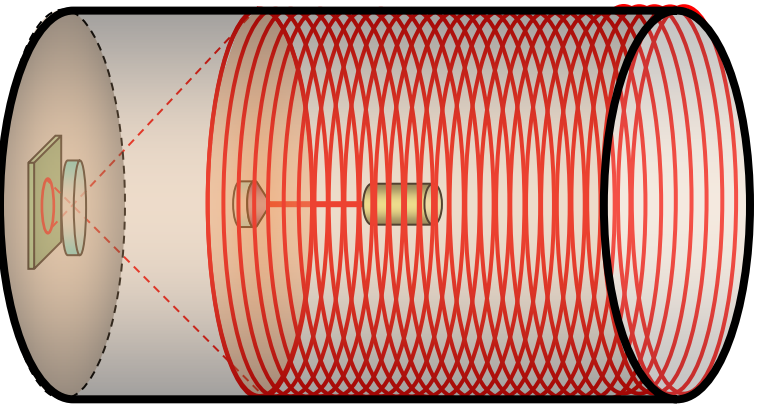


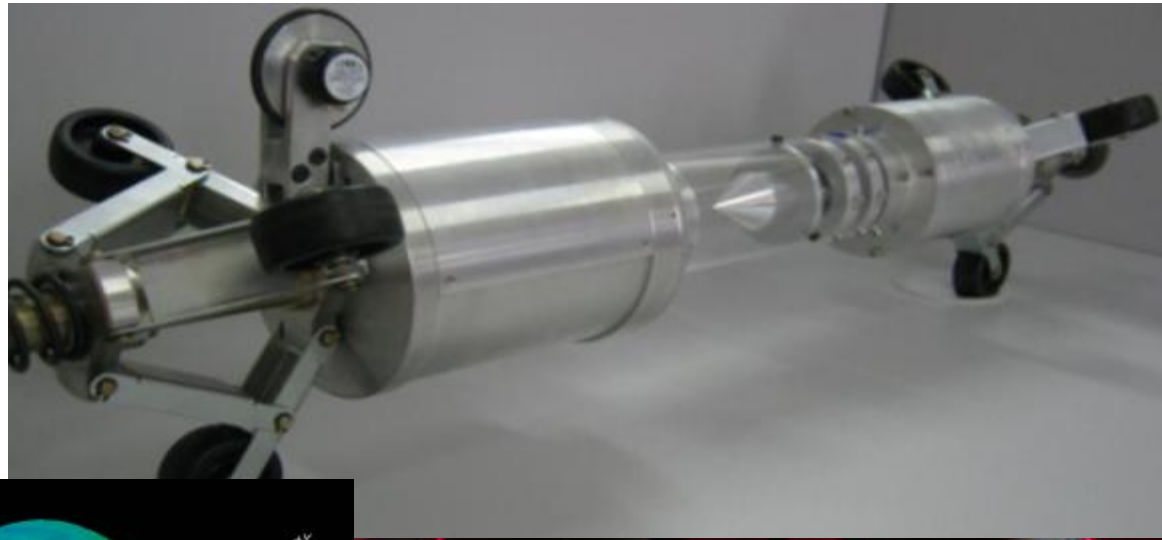
Exemplo de aplicação do sistema indoor-GPS. Exatidão típica: **1 mm**.

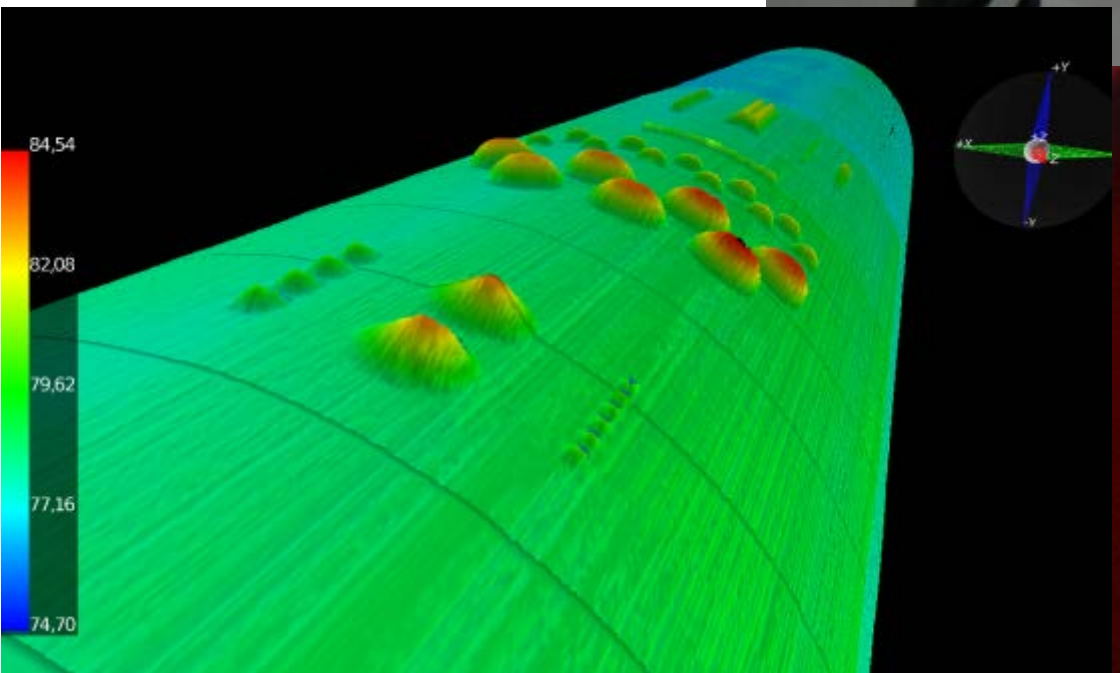
Laser Tracer: até 10 m, incerteza: 3 µm

Optical inspection of composites

Optical inspection of inner geometry of pipes







Metrology & Instrumentation

- Six professor
- Two labs
  - Metrology and automatic measurement
  - Oil, gas and energy institute

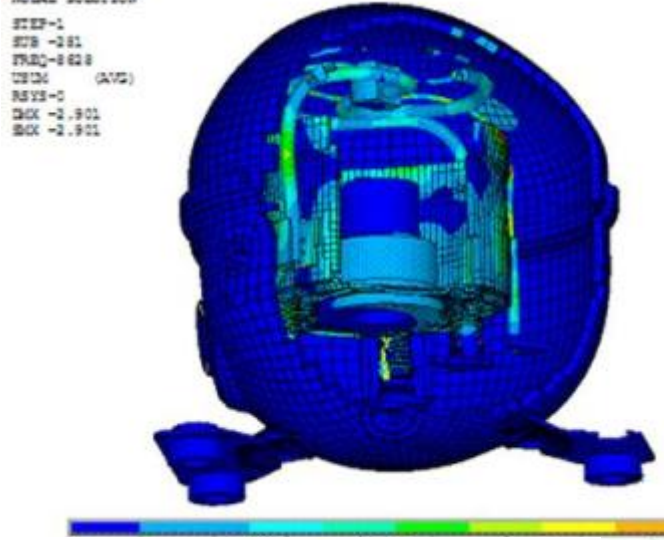

Mechanical Systems
Design

Mechanical Systems Design

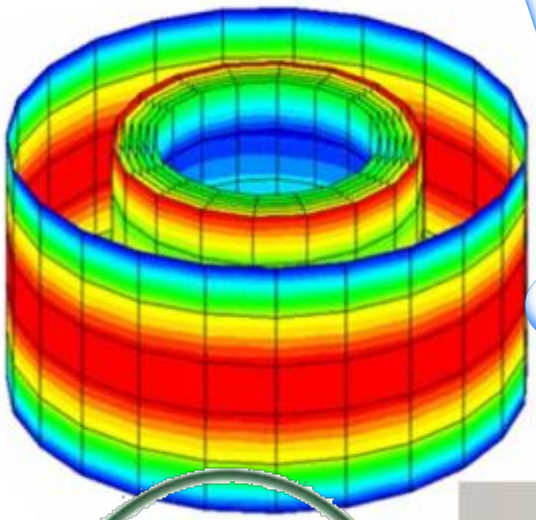
- Research topics:
  - Industrial Products Design and Development Methods
  - Computer aided project development systems.
  - Machines and equipment prototyping.
  - Functional reliability and maintainability of mechanical systems
  - Expert systems applied to the project
  - Design of hydraulic and pneumatic systems
  - CAE / CAD systems
  - Robotics
  - Design of mechatronic systems

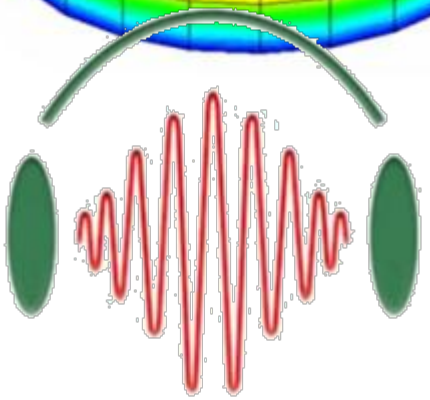
Mechanical Systems Design

- Eight professors
- Three laboratories:
  - Hydraulic and Pneumatic systems
  - Integrated Products Development
  - Robotics



Vibrations & Acustics





Vibrations & Acoustics

- Research topics:
  - Dynamic characterization of viscoelastic materials
  - Modal control and viscoelastic neutralizing devices
  - Active control of flexible structures vibrations
  - Noise and vehicular vibrations
  - Noise control / hearing protectors
  - Predictive maintenance and defect detection in rotating machinery by vibrations
  - Underwater acoustics
  - Structural acoustics
  - Psychoacoustics

Vibrations & Acoustics

- Five professor
- Two laboratories:
  - Industrial vibroacustics
  - Vibration and acustics technologies

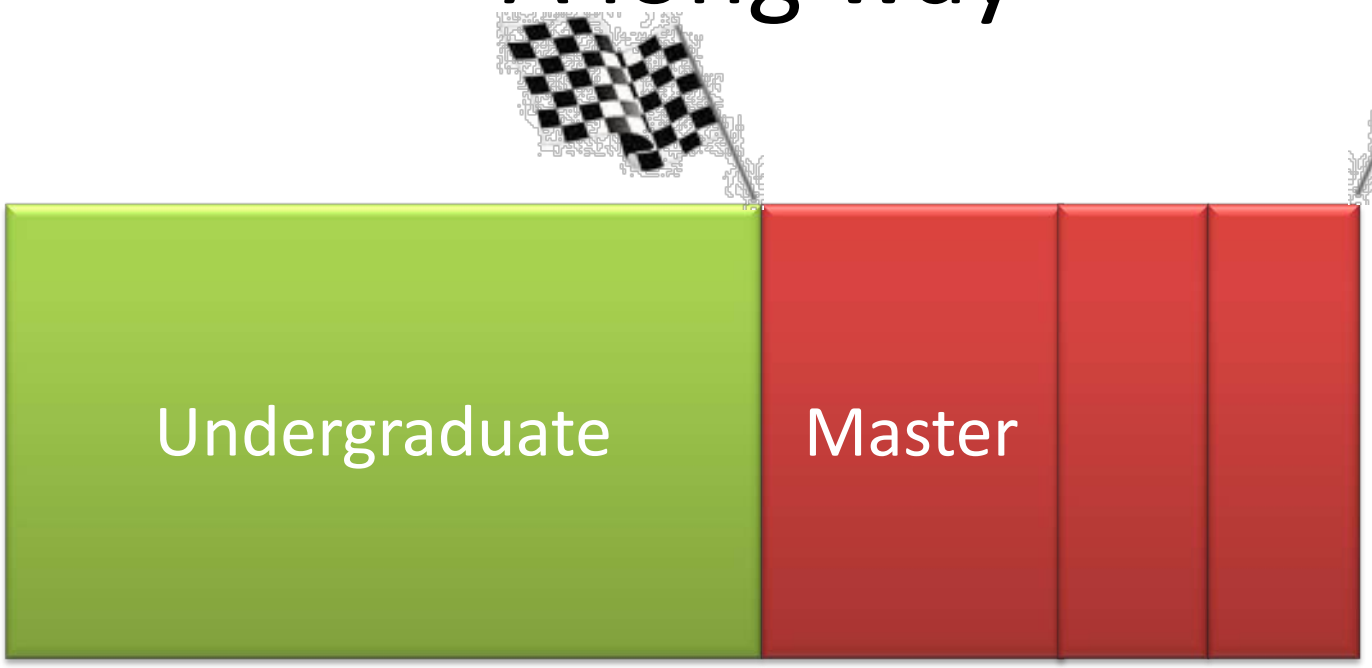
Nota 7

POSMEC
Programa de Pós-Graduação em Engenharia Mecânica

4

Undergraduate-Graduate Integration (GPGEM)

A long way



5 years

2 a 4 years

7 to 9 years

Nota 7

POSMEC | Programa de Pós-Graduação em Engenharia Mecânica

Undergraduate program in Mech. Eng.

FASE 1		FASE 2		FASE 3		FASE 4		FASE 5		FASE 6		FASE 7		FASE 8		FASE 9		FASE 10	
Cálculo A	4	Cálculo B	4	Cálculo C	5	Cálculo D	4	Física Teórica B	5	Projeto Integrado em Engenharia Mecânica	4	Organização Industrial	3	Planejamento do Trabalho de Curso	2	Trabalho de Curso	8	Estágio Profissional em Engenharia Mecânica	22
Geometria Analítica	4	Álgebra Linear	4	Computação Científica II	4	Metodologia de Projeto em Engenharia Mecânica	4	Conformação de Metais e Moldagem de Polímeros	4	Laboratório em Manufatura e Metrologia	4	Soldagem	2						
Física Básica para Engenharia	4	Estática para Engenharia	4	Fundamentos da Termodinâmica	4	Mecânica dos Fluidos I	4	Usinagem dos Materiais	4	Elementos de Máquinas	5	Controle de Vibrações	4						
Química Tecnológica	4	Física Experimental para Engenharia A	2	Mecânica dos Sólidos A	4	Termodinâmica Aplicada	2	Mecanismos	3	Controle de Sistemas Dinâmicos	4	Introdução à Engenharia Ambiental	2						
Introdução à Engenharia Mecânica	4	Desenho e Modelagem Geométrica	5	Materiais de Engenharia	4	Mecânica dos Sólidos B	6	Transmissão de Calor I	3	Transmissão de Calor II	3	Eletrônica	4						
Representação Gráfica Espacial	3	Computação Científica I	3	Estatística e Metrologia pra Engenheiros	4	Mecânica II - Dinâmica	3	Mecânica dos Fluidos II	2	Eletrotécnica Geral	2	Tecnologia e Desenvolvimento	4						
		Ondas e Calor	4					Laboratório em Propriedades Mecânicas	3										
								Laboratório em Ciências Térmicas	2										
	23		26		25		23		26		22		19		2		8		22
										1 OPT	3			5 OPT	15	5 OPT	14		
	23		26		25		23		26		25		19		17		22		22
414	23	882	49	1332	74	1746	97	2214	123	2664	148	3006	167	3312	184	3708	206	4104	228

Elective courses
Graduation Project
and internship

Nota 7

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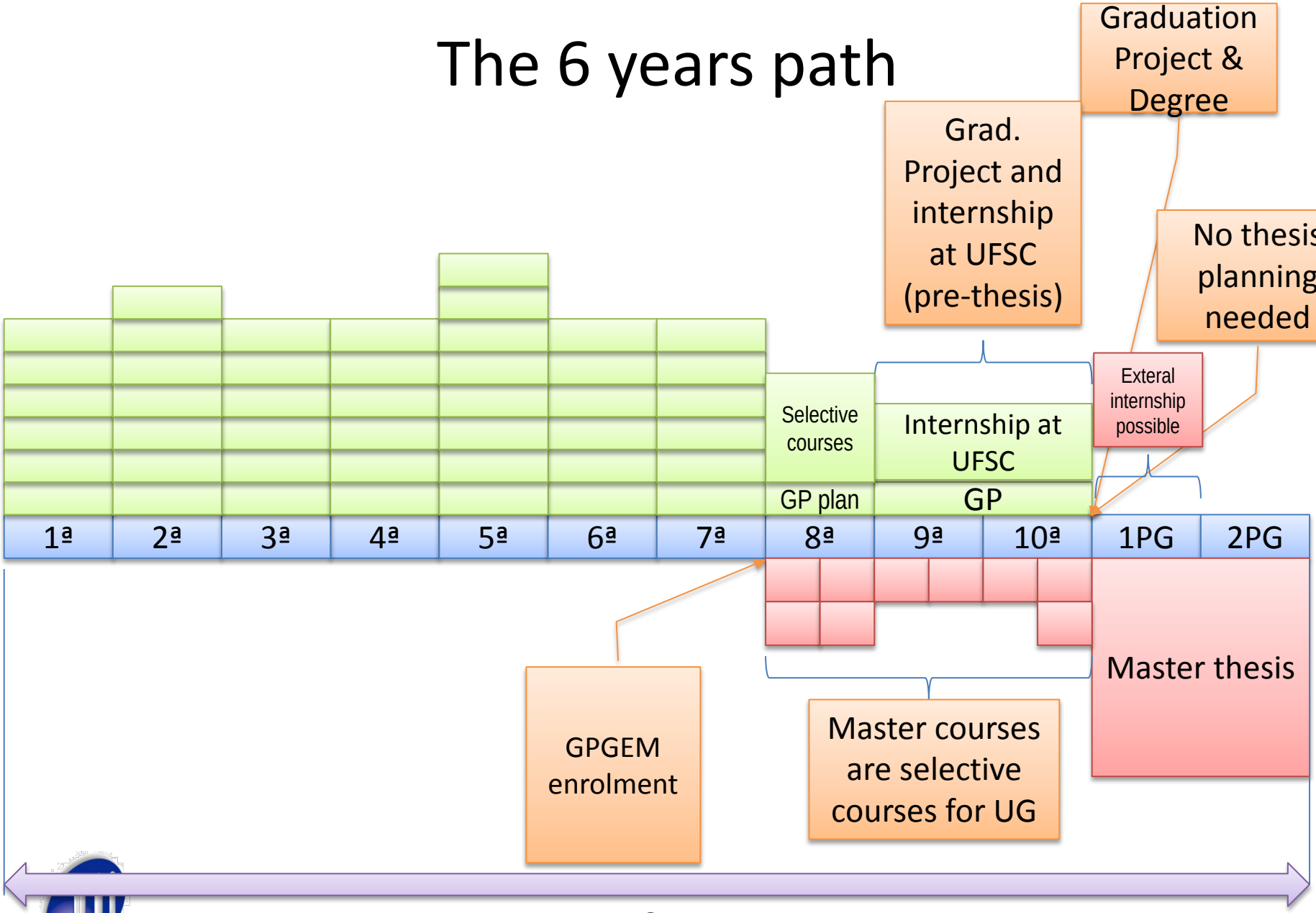
Opportunity window

The 6 years path



GPGEM highlights

- UG student can access over 120 master courses and account them as advanced selective courses.
- UG terms (18 weeks) are compatible master/PhD terms (9 weeks).
- Graduation projects become a pre-thesis.
- High level students save time and access advanced topics.
- Reduce mean time statistics and increase scholarship availability.

Nota 7

POSMEC
Programa de Pós-Graduação em Engenharia Mecânica

7

Final Remarks

Highlights of POSMEC

- Very active and strong research groups and labs.
- Strong cooperation with industry.
- International activities (conferences, program committees, conferences chairs, TC members)
- Strong international cooperation.

Academic International Cooperation

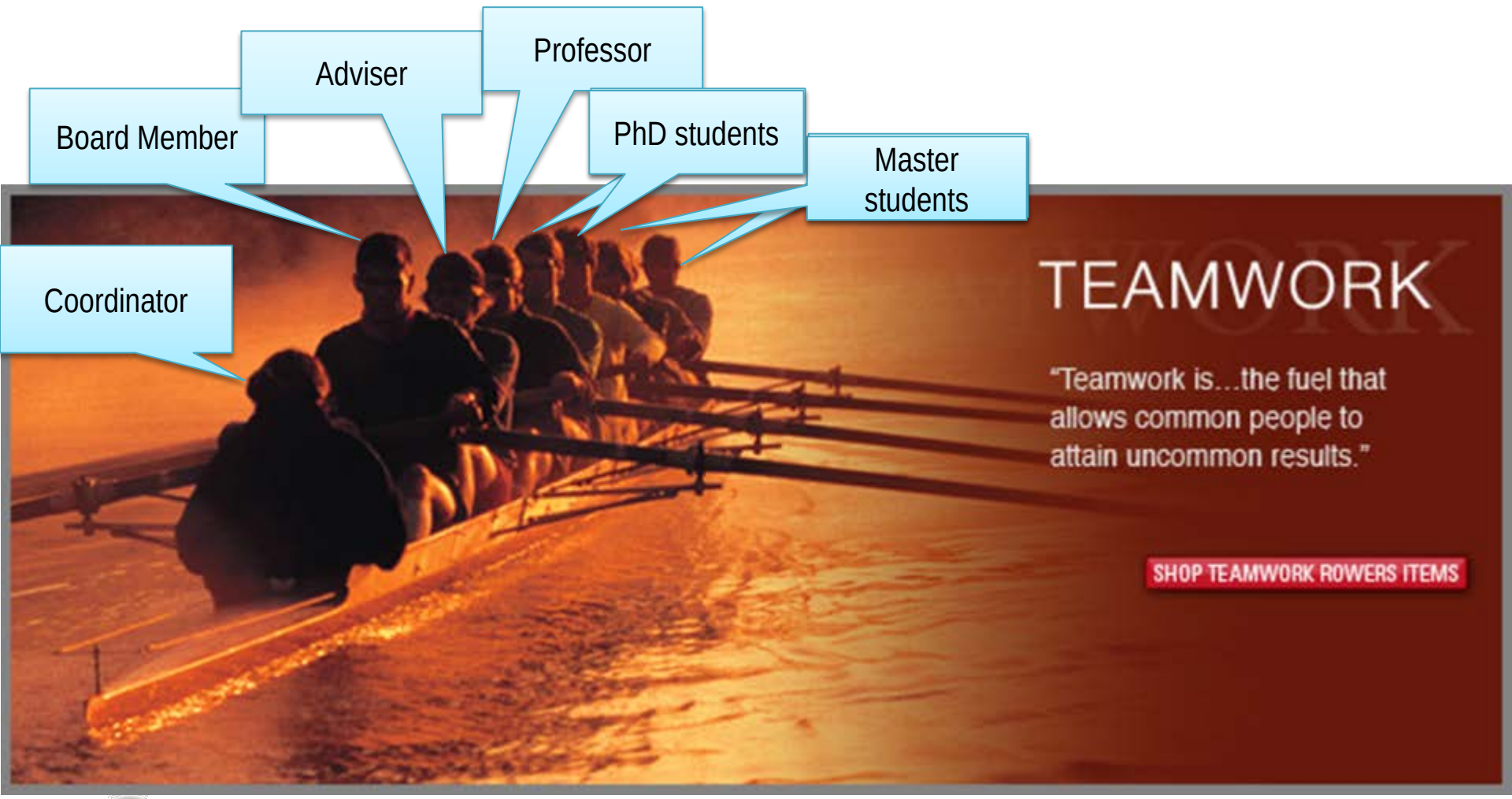
- Canada
  - University of Victoria
- Colombia
  - Universidad Pontificia Bolivariana
- Denmark
  - Risø Institute – Technical University
- France
  - Aix-Marseille University
  - Ecole Nationale Supérieure des Mines de Saint-Etienne (EMSE)
  - Institut National Polytechnique de Grenoble (INPG)
  - INSA de Lyon
  - INSA de Rouen
  - INSA de Rennes
  - INSA de Toulouse
  - Université Lille
  - Université de Technologie de Compiègne
- Germany
  - Aachen (RWTH)
  - Berlim
  - Clausthal University of Technology
  - Ilmenau
  - Karlsruher Institut für Technologie
  - Stuttgart
  - Technische Universitaet Dresden
- Italy
  - Padova
- Mexico
  - Universidad Autónoma de Nuevo León UANL
- Netherlands
  - University of Twente
- Poland
  - Cracow University of Technology
- Portugal
  - Aveiro
- Sweden
  - Linköping University
  - Royal Institute of Technology
- Switzerland
  - École Polytechnique Fédérale de Lausanne
- Tchek Republic
  - Brno University of Technology
- UK
  - Imperial College London
  - University of Nottingham
- United States
  - Clemson
  - Texas A&M
  - University of Michigan
  - University of Wisconsin-Madison
  - Virginia Polytechnic Institute

POSMEC next steps

- Internationalization (students and faculty exchanges , sheared courses, joint graduation programs).
- Use of internet oriented learning technologies.
- Classes in English.


Professor
Adviser
Board Member
PhD student
PhD student
Professor
Master student
Board Member
Master student
Adivser
Coordinator
That is not the way we work!

Here we do teamwork



Thank you for your attention!