

# **PUC-Rio**

---

# **Pipeline Engineering**

## **Research and Education**

(2022)

# The Campus at Gavea



# The University

---

- Founded in 1941
- Excellence in education & research
- Leadership role in Brazil
- Four Centers:
  - Center for Human Sciences
  - Center for Social Sciences
  - Center for Science and Technology
  - Medical Center
- High quality undergraduate, graduate and extension programs:
  - 11,000 undergraduate students
  - 2,400 graduate students
  - 3,000 extension students
  - 1,000 foreign exchange

# CENTER FOR SCIENCE AND TECHNOLOGY - CTC

---

- CTC is ranked one of the best among R&D centers in Brazil
- Highly multidisciplinary research environment
- The center groups all science and engineering departments:
  - Chemistry
  - Mathematics
  - Physics
  - Computer Science
  - Civil Eng.
  - Electrical Eng.
  - Industrial Eng.
  - Materials Eng.
  - Mechanical Eng.
  - Telecom. Institute
  - Technology Institute
  - Energy Institute

# CENTER FOR SCIENCE AND TECHNOLOGY - CTC

---

- 2,600 undergraduate and 1,100 graduate students enrolled in the Center
- About 200 full-time faculty, all holding doctoral degrees from leading universities in the world
- International cooperation with universities in Europe and the US
- Strong basic and applied research activities

# PIPELINE ENGINEERING PROGRAM

---

- Extension (Continuing Education – Postgraduate Certificate)
  - 360 hours plus monograph (18 plus 6 months)
  - Typical class with 40-60 students
  - About 370 graduate students since 2000
- MSc & DSc Graduation in Mechanical Engineering with thesis on a specific topic of pipeline interest
  - 24 or 48 total graduate credits, respectively
- Partnership with Petrobras in the foundation of CTDUT - Technology Center in Pipelines
- Professional accreditation at CREA-RJ – Engineering and Architecture Council of State of Rio de Janeiro

# PIPELINE ENGINEERING PROGRAM

---

- Objective. Training of practicing engineers to understand and work in areas associated with the transport of oil and gas, including: design, construction, installation, maintenance, operation and integrity of onshore and offshore pipeline systems.
- Teaching. The Extension program consists of lectures on six subjects, seminars, field trips and personal supervision of monographs covering relevant topics in pipeline engineering. The program is presented by a mix of permanent professors from the University and a group of highly qualified visiting lecturers from industry.
- Duration. The course is offered online every 18 months in three semesters, March-July, August-December and March-July, two classes per week for a total of eight hours per week. Supervised monographs occur normally from March to August, after the class period, ending in September.

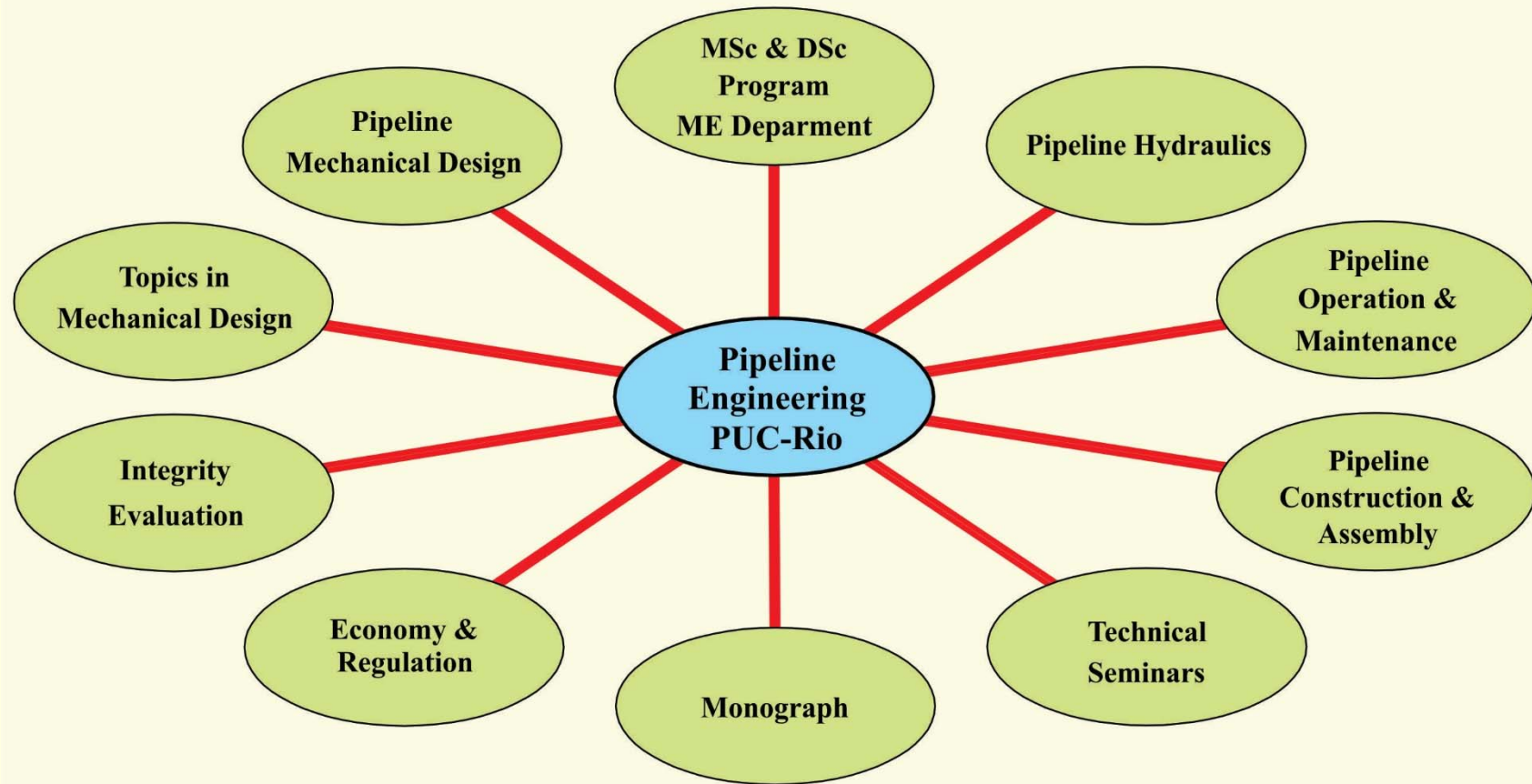
# PIPELINE ENGINEERING PROGRAM

---

- Mechanical Design of Pipelines (60 hours)
- Thermal Hydraulics in Liquid and Gas Pipelines (60 hours)
- Topics in Pipeline Design (45 hours)
- Structural Integrity Assessment of Pipelines (60 hours)
- Topics in Pipeline Operation (60 hours)
- Topics in Pipeline Construction, Installation and Operation (45 hours)
- Economy & Regulation (National & International)
- Pipeline Engineering Seminars (30 hours)



# PIPELINE ENGINEERING PROGRAM



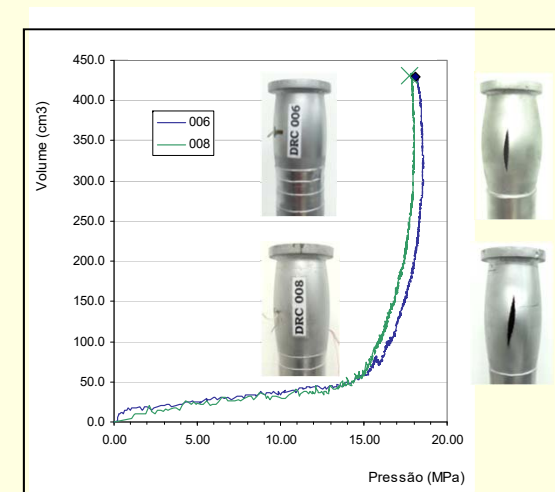
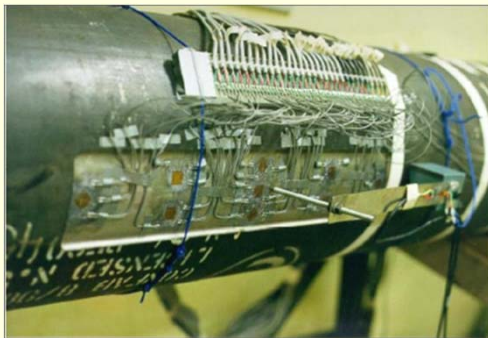
# RESEARCH ACTIVITIES

---

- Pipeline integrity
- Development of intelligent pig for pipeline inspection
- High-yield strength steels for pipeline applications
- Soil-pipeline interaction studies
- Expert systems for pipeline safety
- Application of optical fiber sensors
- Wax deposition and heat transfer in subsea pipelines
- Pipeline pigging and wax removal simulation
- Pipeline thermo-hydraulic simulation

# Structural Integrity

- Structural integrity evaluation
- Risk analysis
- Risk-based inspections
- Repairs and reinforcements with composite materials



# Structural Integrity

## International Joint Industry Project

**MIT** – A research project aimed at improving the prediction of failure of pipelines containing interacting corrosion defects.

### *Sponsors*

*Petrobras*

*Tenaris – CONFAB*

*DNV*

*Shell*

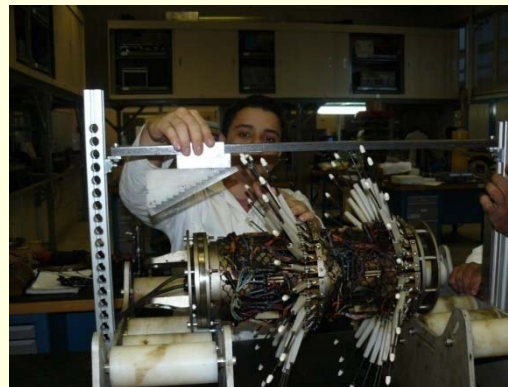
*Statoil*

*TransCanada*



# Center for Inspection Technology

- Development of inspection tools for pipelines, ships and structures
- Instrumented PIGS for pipeline inspection



**ROV for ship hull inspection**



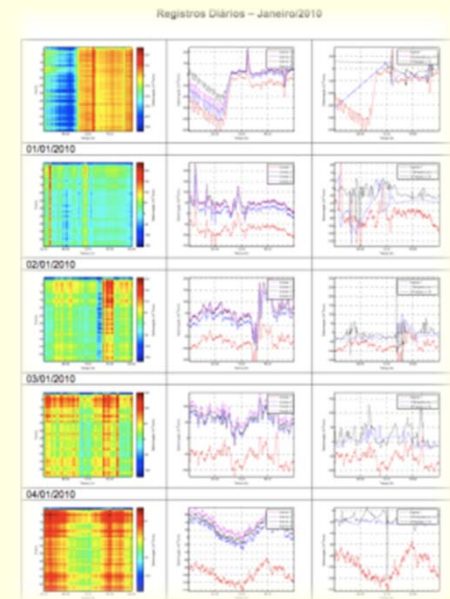
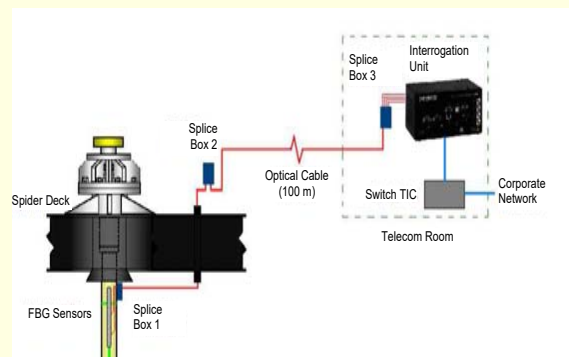
# Optical Fiber Sensors Laboratory

## Fiber Optic Downhole Gauges



# Optical Fiber Sensors Laboratory

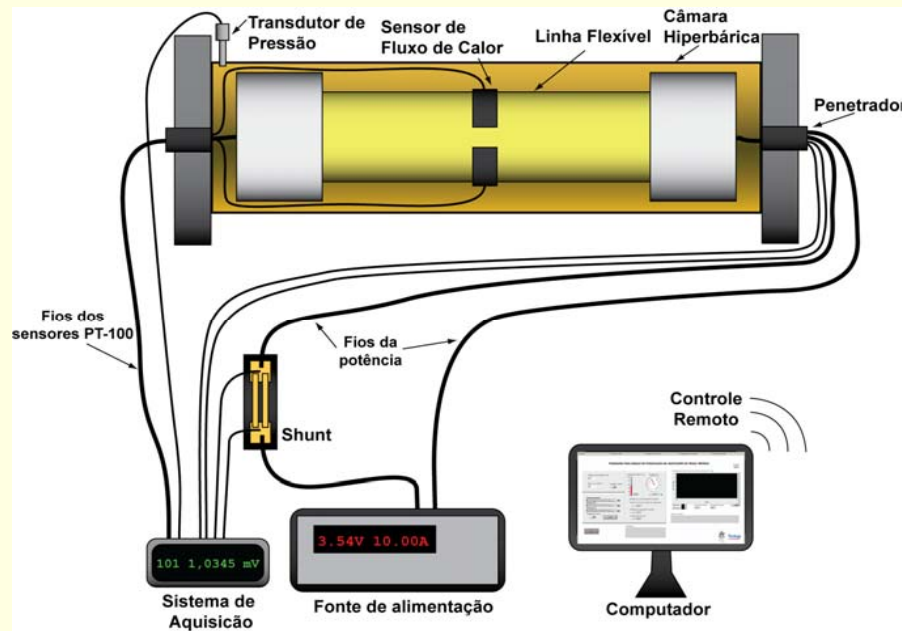
## Structural Health Monitoring of Flexible Risers



# Flow Assurance Group

Fluids Engineering Laboratory (Mechanical Engineering Department)

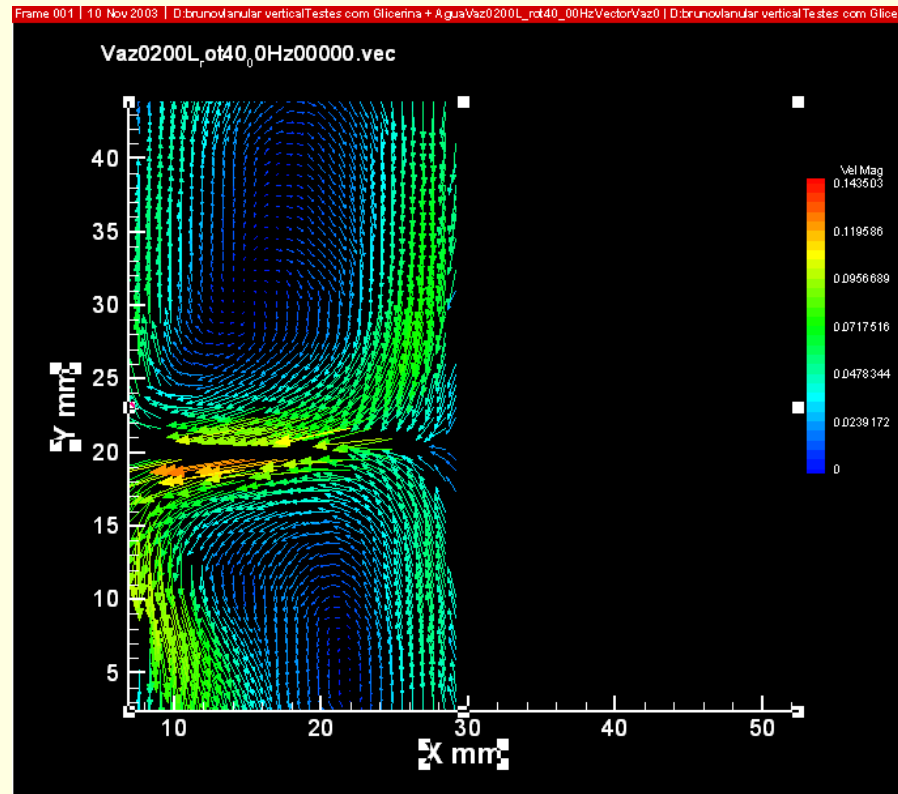
Heat transfer in subsea flow lines





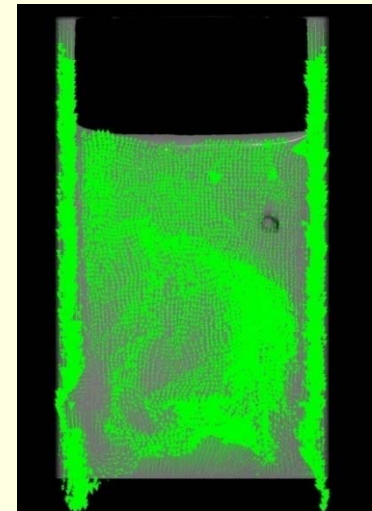
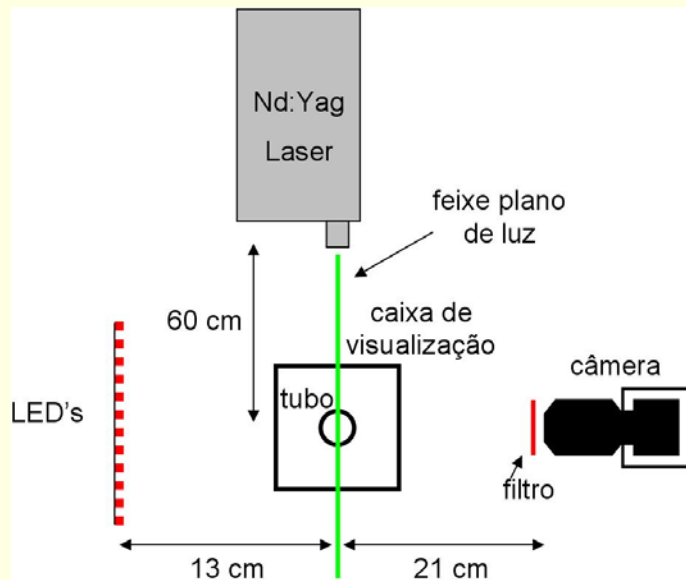
# Fluids Engineering

## PIV - Flow visualization through annular region with rotation: well drilling model



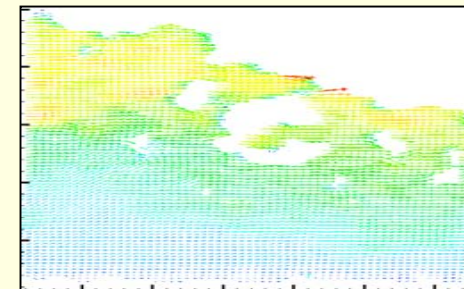
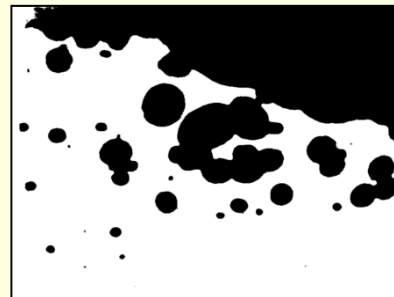
# Fluids Engineering

## Laser-based measurements in two-phase flow



**Ascending  
Taylor  
Bubble**

**Horizontal Slug**



# CTDUT – University-Industry Cooperation





# Startup Companies (Oil & Gas Sector)



2000

***gavea sensors***  
*measurement solutions*

2003



**[A]TI[VA] ] ] ] ]**  
TECNOLOGIA & DESENVOLVIMENTO

2006

# Startup Companies (Oil & Gas Sector)



2008

**I-Dutto: Identificação Eletrônica**



2009

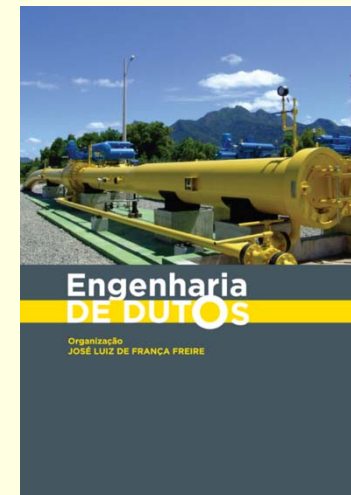


2010



# Reference Book – Pipeline Engineering Handbook

- ABCM, PUC-Rio, Transpetro - Petrobras
- Editor: Prof. José Luiz de França Freire, PhD – PUC-Rio
- 47 Chapters by renowned specialists with over 1000 pages
- New Pipeline Engineering Handbook, Edited by Sringer
- New 2nd Edition to be published in 2023
- Organized by José Luiz de França Freire, Marcelino Gomes and Marcello Rennó



# Thank You!

**Mechanical Engineering Department – PUC-Rio**

**Phone: +55 21 3527-1108**

**<http://www.mec.puc-rio.br/>**

**Prof. Sidney Stuckenbruck, PhD – [stuckenbruck@gmail.com](mailto:stuckenbruck@gmail.com)**

**Prof. Luís Fernando A. Azevedo, PhD – [lfaa@puc-rio.br](mailto:lfaa@puc-rio.br)**

**Prof. Renato B. Vieira, PhD – [renatovieira@puc-rio.br](mailto:renatovieira@puc-rio.br)**

**Prof. Ivani S. Bott, D.Sc – [bott@puc-rio.br](mailto:bott@puc-rio.br)**

**Prof. José Luiz de França Freire – [jlfreire50@gmail.com](mailto:jlfreire50@gmail.com)**

**Pipeline Engineering Course: <http://engdutos.usuarios.rdc.puc-rio.br/>**