Ocean Technology

Underwater Acoustics

C.E. Parente
COPPE/Ocean Engineering Program
Federal University of Rio de Janeiro
LabSonar

Purpose – Research and development in acoustic signal processing and propagation

• Expertise Areas
  • Detection and Classification
  • Beamforming
  • Blind Source Separation
  • Signal Synthesis
• Detection and Classification

  • Novelty detection using:
    • SVM (Support Vector Machine)
    • Neural Networks (Supervised and Non-supervised)

  • Classification using:
    • Neural Networks
    • Support Vector Machine
    • Neural Network Ensemble
• Beamforming

  • Direction of Arrival (DOA) Estimation using:
    • Delay and Sum in a Cylindrical Hydrophone Array (CHA)
    • Frequency Invariant Beamforming (FIB) in a Linear Array
  • Application
    • Narrowband signals
    • Wideband signals
• Blind Source Separation
  • Improve the detection and classification using:
    • Independent Component Analysis (ICA) algorithms
    • Non Negative Matrix Factorization (NMF) algorithms
  • Application
    • Low Frequency Analysis Recording (LOFAR) analysis
    • Demodulation Envelope on Noise (DEMON) analysis
• Signal Synthesis
  • Simulation of various modes of underwater signal propagation on the ocean using digital filters
• Application
  • In shallow waters
  • In deep waters
• Thesis in progress
  • D.Sc. thesis
    • Novelty Detection in Passive Sonar System
    • Specialist Committee Classification for Passive Sonar System
  • M.Sc. thesis
    • Frequency Invariant Beamforming in Wideband Passive Sonar Signals
    • Signal to noise ratio analysis in a Cylindrical Hydrophone Array
LIOc
Oceanographic Instrumentation Laboratory

Purpose – Research and Development in Underwater Acoustics and Ocean Instrumentation

• Expertise Areas
  • Shallow water propagation
  • Acoustic instrumentation
  • Ocean wave data analysis and modelling
  • Metocean buoys
Shallow water propagation

- Possibility of total reflection
- Low frequency = small absorption
- Cylindrical losses
- result = long distance propagation
Diferença de fase entre A e D:

\[ \phi = k (AB + BC + CD) + \pi + \varphi = 2 \pi \]
Shallow water propagation
Shallow water propagation

- Range determination with passive techniques
- Bottom geoacoustic parameters determination
- Acoustic tomography
- Seebeck acousticsyren effect in underwater propellers
- Studies in volume scattering
Acoustic Instrumentation

- Systems for noise measurements at sea
- Array developments
Ocean wave measurements, data analysis and modelling

• Use of MEMS in wave measurements

• Development of techniques for wave data analysis using wavelets and presentation of spectra evolution.

• Studies of wave climate along the brazilian coast using WW3 and SWAN models
wave and wind direction
day of month
20.0 a 10.2 10.2 a 7.75 7.75 a 3.93 3.93 a 2.50
period band in seconds
CORRENTE - BACIA DE CAMPOS

rumo em graus: corrente e vento

profundidade da camada - metros

vento

veloc.max. camada - cm/s
Metocean Buoys

- R&D in metocean buoys

Brazilian Metocean Buoy

REMETEOO (1.200 m) Buoy

REMO (2.000 m) Maintenance

REMO (300 m) Deployment
Joint work with UE

OAEX – Ocean Acoustic Exploration – Acoustic experiments at sea – Participants: COPPE, BN /IEAPM, University of Algarve-Po, Université Libre de Bruxelles, University of Victoria - Canada 2007-2010

Cabo Frio RJ
Other collaborations with UE

Students exchange:
University of Algarve – 1 M.Sc., 1 D.Sc.
Université Libre de Bruxelles – 1 M.Sc.

Memorandum of Understanding – with UoS –
University of Southampton
1 Student from UoS – D.Sc. at COPPE
Suggestions for Collaborations Between Brazil and Europe

• Embedded Systems for: Multi Parameters Data Acquisition platforms, Data Quality Control and/or Data processing

• Autonomous Underwater Vehicles (AUVs) and Autonomous Surface Vehicles (ASVs)

• Calibration Centres for Oceanographic Sensors

• Interchange with UE – universities and enterprises – of technology in data fusion, data acquisition, remote sensing and surveillance, connected with passive sonar systems. We would also welcome visiting professors.
Thank you