Basque Center for Appied Mathematics (BCAM)

Finite Element Methods:

Adaptivity, Multiphysics and Parallelization.

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overview

- **Introduction:**
  1. **Motivation and objetives.**
  2. **Introduction to Finite Element Methods.**
- **Adaptivity and Multiphysics:**
  1. **Goal-oriented adaptivity.**
  2. **Multiphysics problems: Description and applications.**
- **Solvers:**
  1. **Direct solvers of linear equations.**
  2. **Iterative solvers of linear equations.**

overview

- **Advanced Methods**
  1. **Parallelization techniques and Inversion Methods.**
  2. **New Discontinuous Galerkin and Petrov-Galerkin methods.**
- **Implementations**
  1. **Implementation details.**
  2. **MATLAB examples.**

motivation

Seismic Measurements

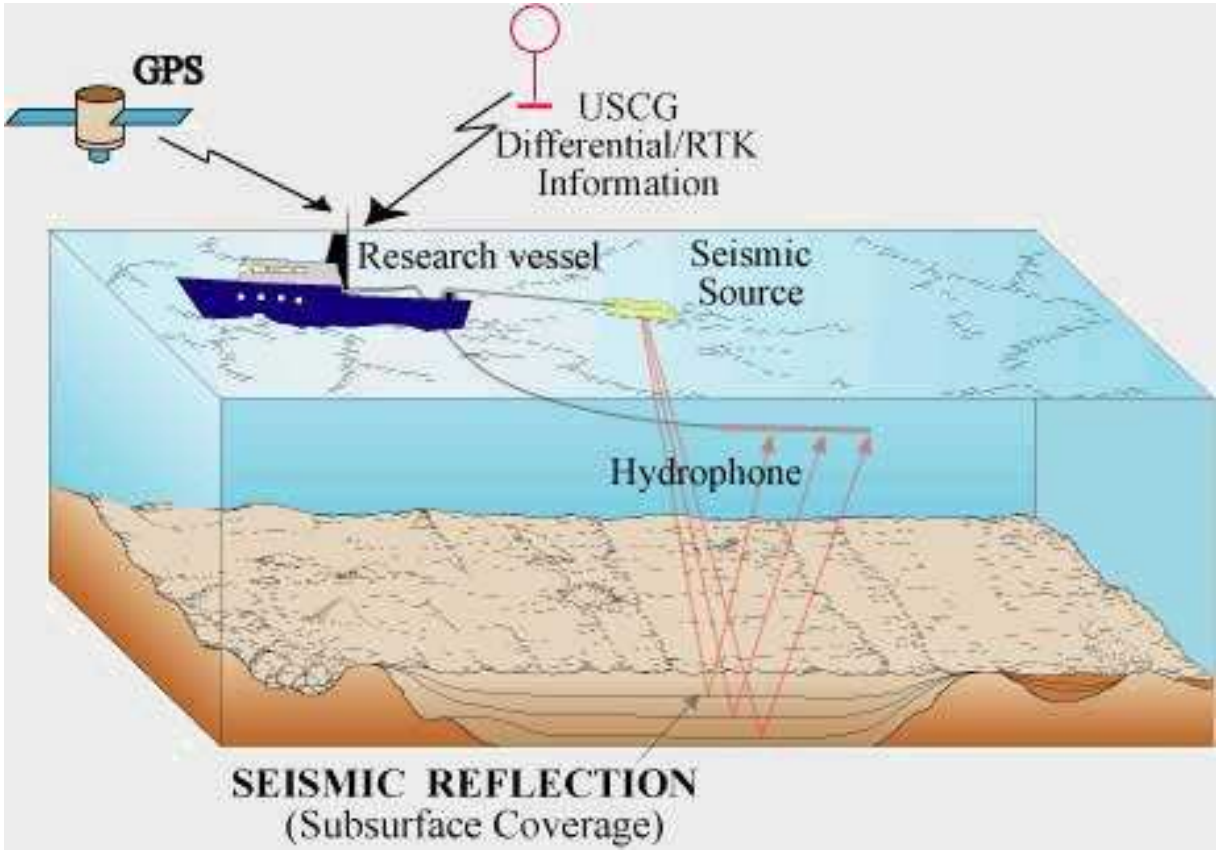


Figure from the USGS Science Center for Coastal and Marine Geology

motivation

Marine Controlled-Source Electromagnetics (CSEM)

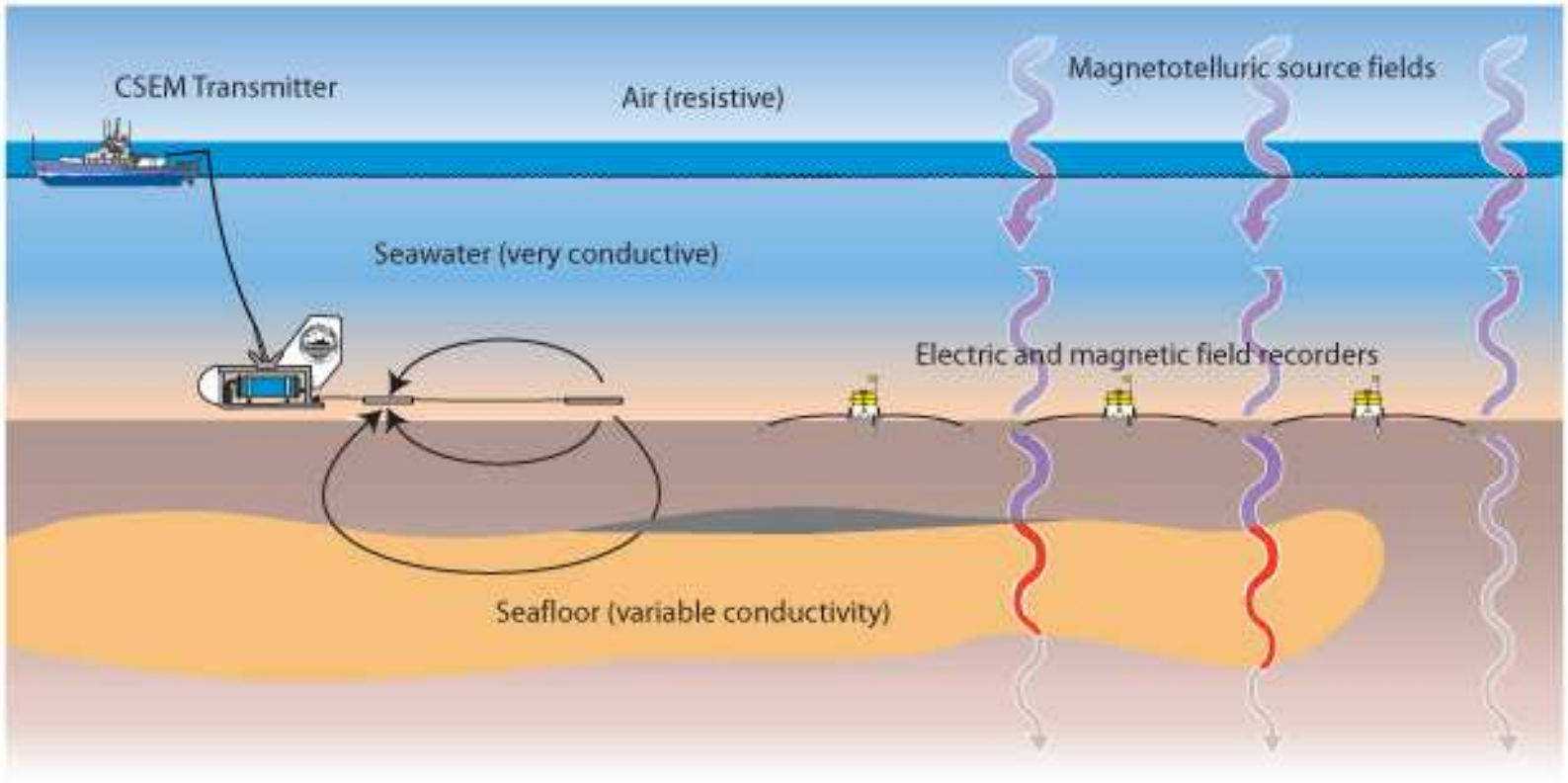
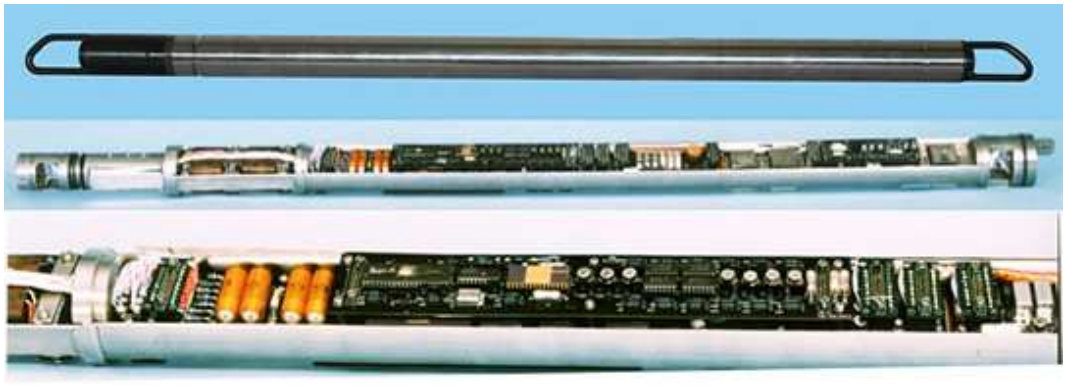


Figure from the UCSD Institute of Oceanography

motivation

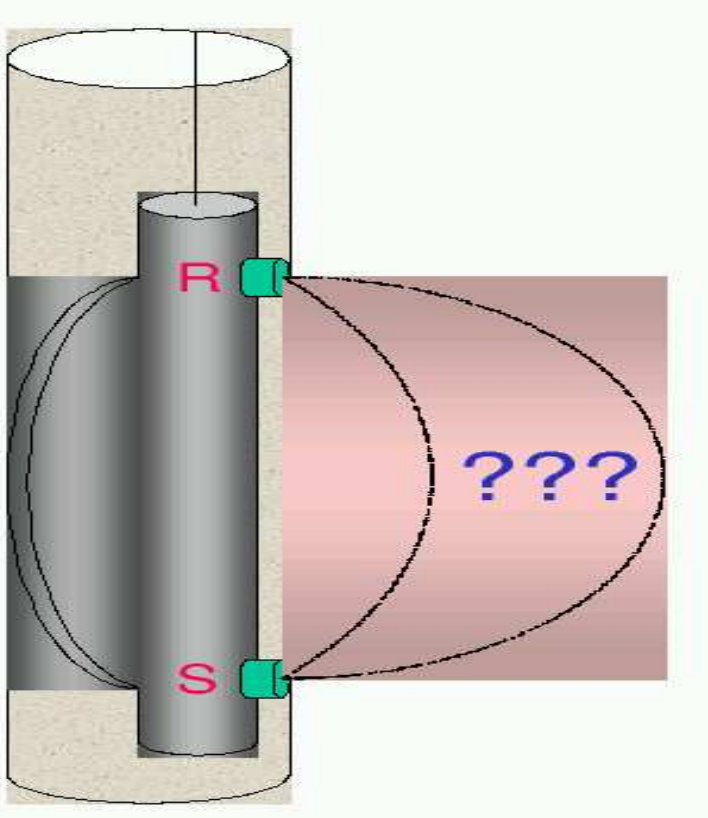
Logging Instruments



Figures from JARI (top), Halliburton Energy Services (bottom-left), and SEG (bottom-right).

motivation

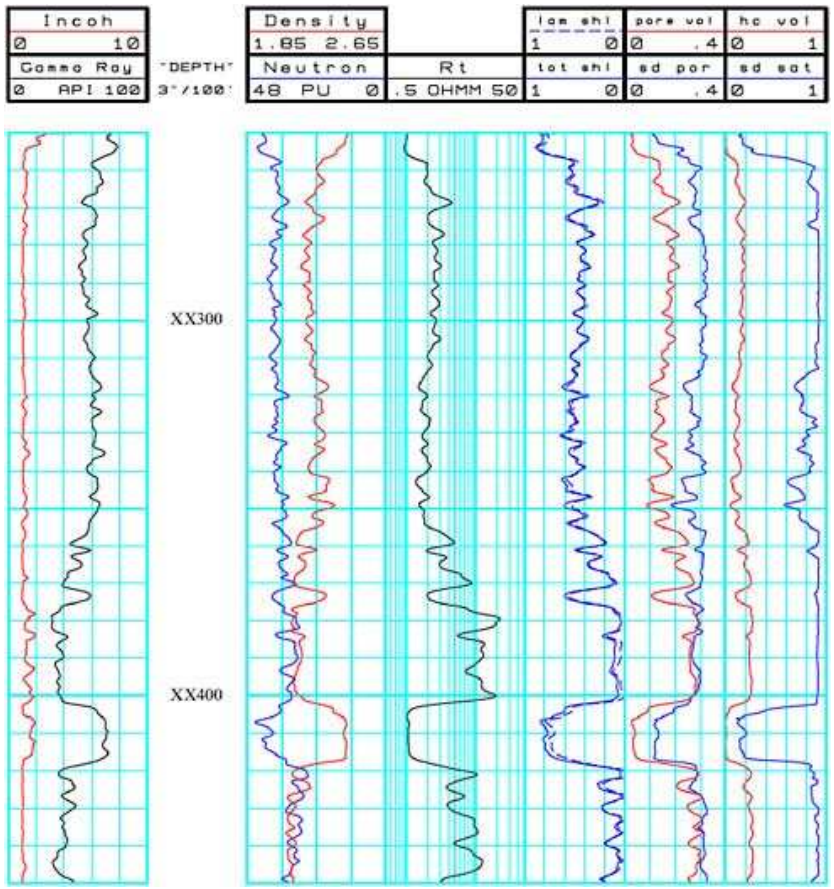
Direct (Forward) and Inverse Problem



Software to solve the DIRECT problem is essential in order to solve the INVERSE problem.

motivation

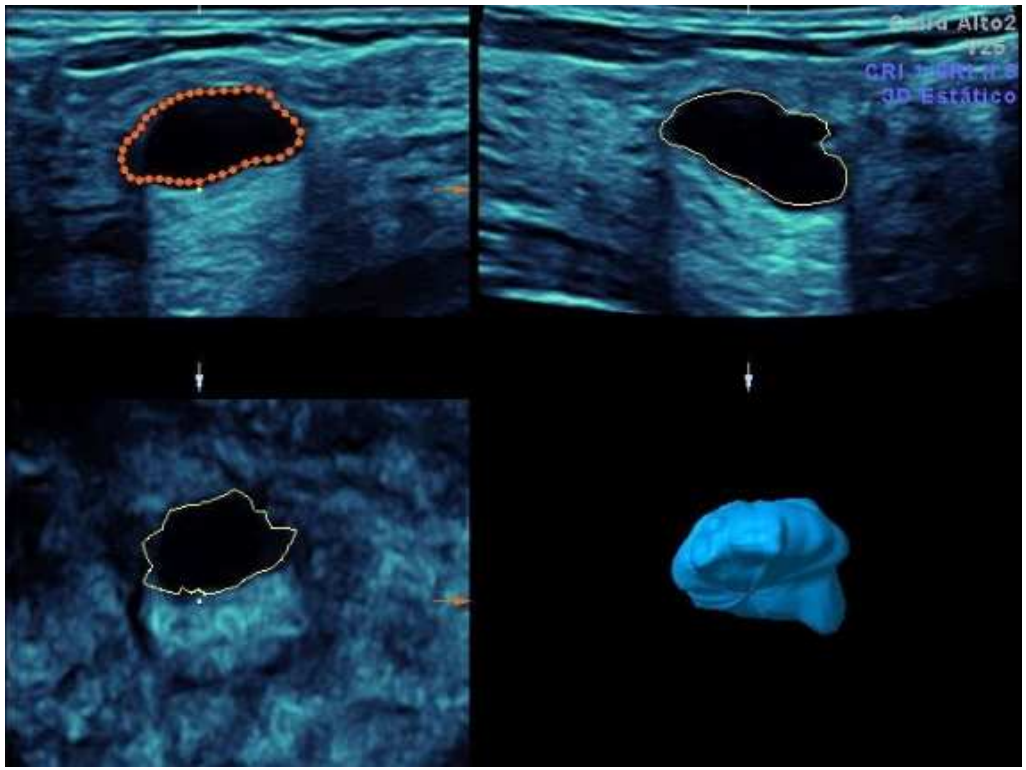
Main Objective: To Solve a Multiphysics Inverse Problem

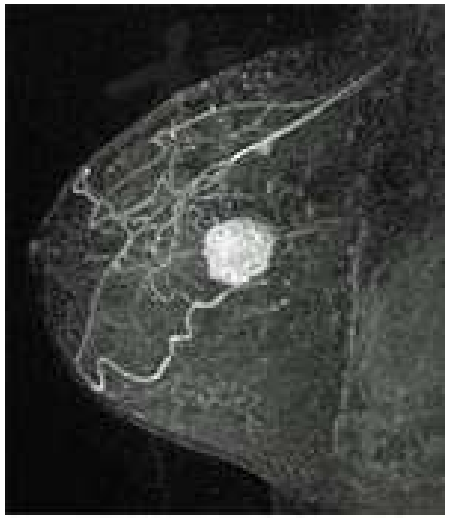


Logging Results based on Multiphysics Measurements
(Figure from Van Popta *et. al.* (2004)).

motivation

Joint Multiphysics Inversion (Medical Application)





Detection of breast cancer using an ecography vs. MRI.