# BME801 Inverse Problem in Bioengineering
# (Spring, 2014)

| Office | College of Electronics and Information, Room 326 |
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## 1. Description

Understand engineering problems as forward and inverse problems with their physical backgrounds and mathematical representations. Understand mathematical backgrounds including vector space, Hilbert space, orthogonality, projection, linear algebra, linear system, least square, SVD, regularization, PDE, FEM and others. Solution methods for forward and inverse problem. Electrical impedance tomography (EIT) using boundary measurement and magnetic resonance electrical impedance tomography (MREIT) using internal measurement.

## 2. Prerequisites

Electromagnetics, vector calculus, linear algebra, numerical analysis

## 3. Text and References

| Title | Author | Publisher | Year | Remark |
|---|---|---|---|---|
| Nonlinear Inverse Problem in Imaging | Seo and Woo | Wiley | 2013 | Main Text |
| Introduction to Inverse Problems in Imaging | Bertero and Boccacci | IOP | 1998 | Reference |
| Discrete Signals and Inverse Problems | Santamarina and Fratta | Wiley | 2005 | Reference |

| Electrical Impedance Tomography | Holder (ed) | IOP | 2005 | Reference |
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## 4. Grading Plan

| Midterm | Final | Homework | Four or more absences |
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| 45% | 45% | 10% | F |

## 5. Schedule

| Week | Topics |
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| 1 | Introduction to forward and inverse problems, linear and nonlinear inverse problems |
| 2 | Vector space, Hilbert space, orthogonality principle and projection |
| 3 | Series expansion and Fourier analysis |
| 4 | Vector calculus: gradient, divergence, curl, and coordinate systems |
| 5 | Maxwell's equations and bioelectromagnetism |
| 6 | Partial differential equations and Green's function |
| 7 | Finite element method |
| 8 | Linear system of equations, least square, SVD and regularization |
| 9 | Impedance imaging problem |
| 10 | Forward and inverse problem in EIT |
| 11 | Measurement technique in EIT |
| 12 | Image reconstruction algorithm in EIT |
| 13 | Forward and inverse problem in MREIT |
| 14 | Measurement technique in MREIT |
| 15 | Image reconstruction algorithm in MREIT |
| 16 | Project demonstration using COMSOL and Matlab |