CEE 696: Optimization in Groundwater Engineering - Syllabus

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Lecture: MW 1:30-2:45 PM, Holmes 248
Office: Holmes 336
Office Hours: T Th 4:00-5:00, or by appointment.
Website: http://www2.hawaii.edu/~jonghyun/classes/S18/CEE696/

1 Course description

Optimization involves finding the"best" solution according to specific criteria. In fact, any engineering problem requires the optimization to make optimal use of resources with the least cost while minimizing failure and risk. Examples in groundwater engineering are maximizing of groundwater supply, minimizing remediation cost, and minimizing the risk of aquifer deletion or saltwater intrusion. Model parameter estimation/calibration can be also viewed as an optimization problem. In this course, we will learn various computational tools that solve optimization problems and mathematical theory behind them. We will apply these methods in a class project, with USGS MODFLOW and related programs. At the end of this course, you will have armed yourself with relevant techniques so that you can apply it to your own research or future consulting projects.

2 Materials

Lecture slides/notes + suggested reading

3 Prerequisites

- undergraduate/graduate level class in linear algebra

- experience in script languages (e.g., MATLAB, R, PYTHON, Julia)

4 Course Objectives

- Learn how to solve various optimization problems

- Learn how to use tools

    - Python programming
    - MODFLOW simulation through Python interface (flopy)

- Use LaTeX to submit Homework, midterm, and project report

5 Topics

1. General optimization theory

2. Numerical linear algebra

3. USGS MODFLOW and related programs

4. Python programming and optimization tools

5. LaTeX

6. Parameter estimation and inverse problem in the context of optimization

6   Grading

- 20% Homework

- 20% Midterm

- 60% Project

7   References

- Peralta, R. C. (2012). Groundwater optimization handbook: flow, contaminant transport, and conjunctive management. CRC Press.

- Ahlfeld, D. P., & Mulligan, A. E. (2000). Optimal management of flow in groundwater systems (Vol. 1). Academic Press.

Books you can download from UHM library site

- Yang, X. S. (2010). Engineering optimization: an introduction with metaheuristic applications. John Wiley & Sons.

- Fletcher, R. (2013). Practical methods of optimization. John Wiley & Sons

Some free or inexpensive materials

- https://www.packtpub.com/packt/offers/free-learning