

# Computational Inverse Problems

Prof. Fabio Marcuzzi<sup>1</sup>

<sup>1</sup>University of Padova  
Department of Mathematics  
Email: [marcuzzi@math.unipd.it](mailto:marcuzzi@math.unipd.it)

**Timetable:** 20 hrs (2 two-hours lectures per week): Classes on Monday and Wednesday, 10:30 - 12:30. First lecture on Monday February 27th, 2017. Room DEI/G, 3-rd floor, Dept. of Information Engineering, via Gradenigo Building.

**Course requirements:** basic notions of linear algebra and, possibly, numerical linear algebra. The examples and homework will be in Python (the transition from Matlab to Python is effortless).

**Examination and grading:** Homework assignments and final test.

**SSD:** MAT/08

**Aim:** We study numerical methods that are of fundamental importance in computational inverse problems. Real application examples will be given for distributed parameter systems. Computer implementation performance issues will be considered also.

## Course contents:

- definition of inverse problems, basic examples and numerical difficulties.
- numerical methods for QR and SVD and their application to the squareroot implementation in PCA, least-squares, model reduction and Kalman filtering; recursive least-squares;
- regularization methods;
- numerical algorithms for nonlinear parameter estimation: Gauss-Newton, Levenberg-Marquardt;
- examples with distributed parameter systems;
- HPC implementations.

## References:

[1] F.Marcuzzi “Analisi dei dati mediante modelli matematici”,  
<http://www.math.unipd.it/~marcuzzi/MNAD.html>