

COLLOCATION AND APPLICATIONS

Block course: 28 January – 1 February 2019; Nussallee 15, seminar room 006 (ground floor)

Lecturer: Prof. Dr. Mirko Reguzzoni

The course is about the collocation approach for data filtering and prediction. It is here framed into a stochastic modelling of the signal, which is particularly useful when a deterministic description of the phenomenon under study is not feasible. The course deals with the theoretical fundamentals of the method, as well as some practical aspects related to its implementation. In this respect, computer laboratories based on MATLAB software are scheduled. Their goal is both to support the comprehension of the theoretical concepts by numerical examples and to study some geodetic applications of the collocation approach.

PRELIMINARY PROGRAM

Theoretical subjects

- The problem of data interpolation and prediction.
- Revision of the least-squares principle and Tikhonov regularization.
- The collocation approach and its deterministic and stochastic interpretation.
- Wiener-Kolmogorov optimization principle.
- Collocation estimates and error estimates with and without change of functional.
- Empirical covariance estimation and examples of covariance models.
- Wiener filter and power spectra in the frequency domain.
- The generalization to the least-squares collocation approach and to the ordinary kriging.

Computer labs by MATLAB software

- Data filtering and prediction of 1D temperature time series.
- Inverse gravimetric problem in 2D planar approximation.
- Geoid determination from gravity data in spherical approximation.

PRELIMINARY SCHEDULE

- Mon. 28, 09:00-12:30: Problem definition: from least-squares adjustment to collocation.
- Mon. 28, 14:00-17:30: Stochastic modelling of the problem.
- Tues. 29, 09:00-12:30: Collocation optimization principle and collocation estimates.
- Tues. 29, 14:00-17:30: Empirical covariance estimation and examples of covariance models.
- Wed. 30, 09:00-12:30: Wiener filter and power spectra in the frequency domain.
- Wed. 30, 14:00-18:00: Labs on 1D temperature time series by collocation.
- Thur. 31, 09:00-12:30: Least-squares collocation vs. kriging.
Problem definition and solution of the afternoon computer labs.
- Thur. 31, 14:00-18:00: Labs on inverse problem and geoid determination examples.
- Fri. 1, 09:00-12:00: Preparation of student reports for the oral examination.
- Fri. 1, 13:00-16:00: Oral examination on student reports.

BIBLIOGRAPHIC REFERENCES

Matheron, G. (1971). The theory of regionalized variables and its applications, Les Cahiers du Centre de Morphologie Mathématique in Fontainebleau, Paris.

Moritz, H. (1980). Advanced Physical Geodesy, Wichmann, Karlsruhe.

Sanso F. (1986). Statistical Methods in Physical Geodesy, Lecture Notes in Earth Sciences, Vol. 7. Springer Verlag, pp. 49-156.

Wackernagel, H. (1995). Multivariate Geostatistics, Springer-Verlag, Berlin Heidelberg.

CURRICULUM VITAE: Prof. Dr. Mirko Regguzoni

Mirko Regguzoni was born in 1974 in Como (Italy). He is an assistant professor at Politecnico di Milano, Department of Civil and Environmental Engineering (DICA) and he is the scientific responsible of the Laboratory of Geodetic and Photogrammetric Measurements at DICA. He graduated in Computer Engineering at Politecnico di Milano in 1999, with honours, with a thesis on the Bayesian classification of remote sensing images. He got a PhD in Geodesy and Geomatics at Politecnico di Milano in 2004, with honours, with a thesis on gravity field determination by satellite gradiometry. From 2004 to 2011 he was employed at the National Institute of Oceanography and Applied Geophysics (OGS), Geophysics of Lithosphere Department.



From 2006 to 2010 he was professor of the course of Navigation Laboratory for the M.Sc. in Environmental Engineering and in Computer Engineering. Since 2011 he is professor of Photogrammetry for the M.Sc. in Environmental Engineering and in Civil Engineering. Since 2014 he has been teaching Markov Chain Monte Carlo Statistical Methods for the Ph.D. in Environmental and Infrastructure Engineering. During the years, he was also involved in practical lectures of several courses at Politecnico di Milano, mainly concerning Probability and Statistics, Positioning, Remote Sensing, and Digital Cartography. He was invited to give seminars on different geodetic subjects at Trento University in 2008 and 2013, at Osaka City University in 2010, at Ferrara University in 2012, and at Bonn University in 2016.

He mainly works on global modelling of the Earth gravity field, especially from satellite mission data. He was involved in the GOCE (Gravity field and Ocean Circulation Explorer) mission data processing, developing the so-called space-wise approach. Other research fields concern statistical data analysis with applications to physical geodesy (estimation of local geoid models and inverse gravimetric problems), GNSS positioning/navigation (cycle-slip determination and correction, use of low-cost receivers and development of the goGPS open source software), and remote sensing (classification of satellite and aerial multispectral images).

He is author and co-author of about 100 publications, half of which at an international peer-review standard. He was guest editor of the Issue n. 5, June 2015, of the Newton's Bulletin and he regularly acts as reviewer for scientific journals. Since 2001 he is member of IAG (International Association of Geodesy) and since 2014 he is member of INFN (National Institute of Nuclear Physics). Since 2014 he is president of the IAG International Service for the Geoid (ISG, ex IGeS). In 2015 he was awarded IAG fellow. He is currently chair of the JWG 2.2.1 Joint Working Group of the IAG Commission 2 on Gravity Field on "Integration and validation of local geoid estimates", member of the IC-SG 7 Joint Study Group of the Inter-Commission Committee on Theory (ICCT) on "Earth's inner structure from combined geophysical sources" and member of the advisory board of the International Gravity Field Service (IGFS). He is co-founder and BOD member of GReD srl (Geomatics Research & Development), a spin-off company of Politecnico di Milano for the technological transfer in the geomatics field.

