



LSGS & RILS RESEARCH SEMINAR

M_{split} Estimation – Theoretical Foundations, Properties, Extensions, and Potential Practical Applications

📅 9 SEP 2026 (WED)

🕒 13:00 - 14:00

📍 GH201, POLYU

🌐 ENGLISH

Dr. hab. Eng. Marek Hubert Zienkiewicz

Professor

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Gdańsk University of Technology (Poland)



ABSTRACT

The method of estimating competing parameters in a split functional model, also known as M_{split} estimation, is an innovative approach to geodetic data processing developed by the Polish geodesist Prof. Zbigniew Wiśniewski. The method was formally derived within the framework of maximum likelihood theory and can be considered as a specific generalization of the family of M-estimation methods. Particular variants of M_{split} estimation, obtained for example by assuming a normal distribution as the probabilistic model of measurement errors, may also be interpreted as a special extension of the least squares method. In simplified terms, the method of M_{split} estimation enables the identification and estimation of competing solutions within a given observational system. This concept creates both theoretical challenges and practical opportunities in such areas as estimation theory, robust statistics, deformation analysis of geodetic networks, and the processing of data obtained using laser scanning technologies. The seminar will introduce the theoretical foundations of M_{split} estimation and its most widely used versions and extensions, including $M_{\text{split}(q)}$ estimation, Shift- M_{split} estimation, and squared $M_{\text{split}(q)}$ estimation. Particular attention will be given to the relationships between M_{split} estimation and M-estimation, maximum likelihood estimation, and the least squares method. The theoretical considerations will be complemented by numerical examples, ranging from elementary linear regression problems to selected geodetic applications, illustrating the practical behaviour of M_{split} estimators. The seminar will also address the robustness properties of the method, approaches to accuracy assessment of competing estimators, and selected potential applications of M_{split} estimation in geodetic practice.

BIOGRAPHY

Dr. hab. Eng. Marek Hubert Zienkiewicz is a University Professor at the Department of Geodesy, Gdańsk University of Technology, Poland. From 2022 to 2023, he served as Deputy Head of the Department of Geodesy. He is the author of 27 scientific publications, including a single-author research monograph on M_{split} estimation theory and 17 articles indexed in the Journal Citation Reports database. According to the Scopus database, his publications have received 333 citations and his Hirsch index is 12. His research interests focus on parameter estimation theory in functional models of geodetic observations, robust statistics, M_{split} estimation, and deformation analysis of geodetic networks. In 2023, he received the Scientific Award of the Gdańsk Branch of the Polish Academy of Sciences for the best creative work in technical sciences published in 2022. He leads the Geodetic Observation Processing Methods research group at Gdańsk University of Technology and has served as principal investigator of several research projects devoted to advanced methods of geodetic data processing. He has completed research internships at Aristotle University of Thessaloniki in Greece. He actively collaborates with research teams in Poland, Greece, Lithuania, the Netherlands and Latvia.

A Recent Advance in Geodetic Deformation Analysis

📅 9 SEP 2026 (WED)

🕒 14:00 - 15:00

📍 GH201, POLYU

🌐 ENGLISH

Dr. Krzysztof Nowel

Assistant Professor

Department of Geodesy

Faculty of Geoengineering

University of Warmia and Mazury in Olsztyn (Poland)



ABSTRACT

One of the important tasks of geodesy is the monitoring of deformations of the Earth's surface and engineering structures. For this purpose, geodetic control networks are established on and around the object under investigation. Geodetic measurements within these networks are then carried out in two or more epochs, and the obtained observations are processed using mathematical methods. This processing is referred to as Geodetic Deformation Analysis. In practice, such an analysis is most often limited to the analysis of single-point displacements of control network points. The presentation addresses this processing. First, a brief review of the conventional computational procedure used in the analysis of single-point displacements will be given, including the corresponding quality control procedure. Next, some problems related to this processing will be highlighted, followed by a presentation of recent advances developed to address them. The first advance concerns deformation model identification, which is the most critical computational step. Two new and currently the most effective approaches to this task will be presented. The second advance concerns the quality control procedure. It will be demonstrated that the conventional procedure provides only approximate description of the quality of single-point displacement analysis. Subsequently, a rigorous procedure that should be used in practice will be presented.

BIOGRAPHY

Dr. Krzysztof Nowel is an Assistant Professor at the Faculty of Geoengineering, University of Warmia and Mazury in Olsztyn (UWM), Poland. His research interests focus on geodetic data processing, with particular emphasis on deformation analysis and GNSS positioning. His work uses mathematical methods to improve the reliability and precision of the results of geodetic data processing and to provide reliable quality control of these results. In 2021, he was awarded a scholarship by the Minister of Education and Science for outstanding young scientists, regarded as the most prestigious research distinction for young scientists in Poland. In 2025, he completed a research internship with the Mathematical Geodesy and Positioning group at Delft University of Technology. He is currently a member of the Joint Study Group (JSG) "Geodetic Quality/Integrity Modelling, Monitoring and Design" operating within the Inter-Commission Committee on Theory (ICCT) of the International Association of Geodesy (IAG), and Chair of the IAG Working Group "Quality Control and Integrity Monitoring of Precise Positioning."

Moderator: Prof. Xiaolong MI, Assistant Professor of LSGS, member of RILS

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