

# **Optimal Pump Scheduling by Non-Linear Programming for Large Scale Water Transmission System**

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## **Abstract**

The large scale potable water transmission system considered in this paper is the Toronto Water System (TWS), one of the largest potable water supply networks in North America. The main objective of the ongoing Transmission Operations Optimizer (TOO) project consists in developing an advanced tool for providing such pumping schedules for 153 pumps, that all quantitative requirements with respect to the system operation are met, while the energy costs are minimized. We describe here, in general, the concept of TOO system, and, in detail, a large-scale non-linear, so-called Full Model (FM), based on system of hydraulic equations, which is solved on 24-hour horizon and delivers optimal aggregated flows and pressure gains for all pumping stations.

**Keywords:** large-scale nonlinear programming, minimum cost operative planning, pump scheduling, water supply

## Biographies



**Jacek Blaszczyk** received his M.Sc. and Ph.D. degrees in Automatic Control from the Warsaw University of Technology, Poland, in 2000 and 2008, respectively. Currently, he is an Assistant Professor at the Research and Academic Computer Network (NASK). His research interests include large-scale nonlinear optimization, optimal control, parallel and distributed computations, numerical software for optimization and linear algebra, and recently, modeling, simulation and optimization of large-scale water distribution systems.



**Krzysztof Malinowski** Prof. of Techn. Sciences, D.Sc., Ph.D., MEng., Professor of control and information engineering at Warsaw University of Technology, Head of the Control and Systems Division. Once holding the position of Director for Research of NASK, and next the position of NASK CEO. Author or co-author of four books and over 150 journal and conference papers. For many years he was involved in research on hierarchical control and management methods. He was a visiting professor at the University of Minnesota; next he served as a consultant to the Decision Technologies Group of UMIST in Manchester (UK). Prof. K. Malinowski is also a member of the Polish Academy of Sciences.



**Alnoor Allidina** received his B.Sc. (Hons) degree in Electrical and Electronic Engineering in 1977, and M.Sc. and Ph.D. degrees in 1978 and 1981 respectively, from the University of Manchester Institute of Science and Technology (UMIST), Manchester, UK. He held a tenured position with UMIST before taking on various industrial positions in the UK and Canada, focusing on the practical application of control theory. In 1991 he started a consulting and system integration business in system automation, optimization and data management. The business is now part of IBI Group, and he is the Vice-President of IBI-MAAK Inc. He is responsible for technology development, business and strategic planning, and management. Current effort is focused on novel approaches to automation and system optimization with a focus on energy efficiency in real-time system control.