**Workshop on Nonlinear Optimization Algorithms and Industrial Applications**

**In celebration of Andrew R. Conn’s 70th birthday and contributions**

June 2 - 4, 2016, [The Fields Institute](http://www.fields.utoronto.ca/describe/host-institutions/fields-institute)

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Optimization is a rich and thriving discipline rooted in applied mathematics but with high impact applications across all the sciences, engineering, industry and business. Whether one wants to minimize the cost of energy, the weight of an airplane, the efficiency of a chip, the cost of manufacturing, maximize accuracy of engineering design, most efficiently mine massive data sets, or maximize profit, the mathematical way to express one’s goal amounts to an optimization problem. Optimization is where mathematics and computing meet to solve problems for high societal impact, including engineering design, optimizing industrial processes, mining huge data sets, optimizing investment portfolios, etc. Some classes of optimization problems are so well understood that problems in millions or even billions of variables are routinely solved on a daily basis; others are so difficult that even small instances can be challenging. This workshop brought together researchers and practitioners from all over the world with a wide variety of expertise from universities and from government and industrial laboratories. It also attracted more than 20 students, postdoctoral fellows and young researchers from all over Canada and the U.S. who presented posters in a well-attended poster session.

The workshop focused on algorithms for solving large-scale continuous optimization problems, both convex and nonconvex, sometimes peppered with integer decision variables, as well as their industrial applications in a variety of contexts. Some talks had a theoretical focus, such as convergence and complexity theory; others had their focus on computational practice, such as efficiency, accuracy, and robustness; finally a significant number of talks offered optimization solutions for problems arising in critical industries, such as smart electricity grids, electricity markets, chip design, optimal oil and gas reservoir management, optimal control of autonomous cars, and financial optimization.

The workshop included 29 plenary and 25 poster presentations covering a broad range of topics according to the scope of the workshop. The first day of the workshop was dedicated to industrial applications. The presentations included: Miguel Anjos (GERAD & Polytechnique Montreal) demonstrated the impact of, and the need for optimization for the emerging Smart Grids; Delphine Sinoquet (Institut Francais du Petrole et Energies Nouvelles, France) presented derivative-free trust region methods for design of mooring lines of floating offshore wind turbines; Bjarne Foss (Norwegian University of Science and Technology) discussed production optimization of offshore oil and gas operations, along with Ulisses Mello (IBM Research, Brazil) who explored optimization challenges in oil/gas reservoir management; Yuying Li (University of Waterloo) presented a novel data mining approach to financial modeling and risk management; Joaquim Martins (University of Michigan) presented the dramatic progress in the area of aircraft wing design via numerical optimization; Marcel Mongeau (ENAC, France) showed the power of continuous and mixed-integer nonlinear techniques for solving aircraft in-flight conflicts; and Chandu Visweswariah (IBM, USA) in an entertaining but enlightening presentation, through case studies from chip design and smarter energy, argued that real life is harder than mathematics. In the lunch break Maplesoft held a demo session, while the posters were presented at the evening reception, after a poster blitz where all poster presenters had 1 minute to present the most important contribution of their research and to entice participants to stop by their posters for more information.

The second and third day of the workshop covered a wide range of algorithmic and computational optimization topics by leading researchers in nonlinear optimization. Presenters came from the US, Canada, UK, France, Portugal, and Belgium. Optimization problems related to the power grid were repeatedly revisited; nonsmooth nonconvex first-order methods were used for sparse signal recovery; factorization-free, variational projection, stochastic Newton and quasi-Newton algorithms, automatic differentiation, and evaluation complexity of nonconvex problems were also presented. The speakers made significant effort to cover the breath of Andrew Conn’s contributions. So, trust region, active set and proximal point methods, derivative-free and space decomposition methods, numerical stabilization and regularization of nonlinear optimization software, and the rapidly growing area of mixed-integer PDE constrained optimization problems were discussed as well. All presentations through the workshop were followed by lively Q&A periods, and discussions continued in the coffee breaks, lunch time, and at the banquet, where Bill Pulleyblank (United States Military Academy) reflected on Andy Conn’s life and numerous contributions to research, to the fabric of the optimization community, and to the economy, both during the first half of his career at the University of Waterloo and the second half at IBM Thomas J. Watson Research Center. Several ad-hoc speakers recalled their interaction with Andy and his wife Barbara, pointed out Andy’s impact on their career and the development of modern nonlinear optimization and its numerous applications in science, engineering, and countless areas of industry.

The workshop provided a fascinating framework to celebrate the 70th birthday of **Andrew R. Conn**, who, arguably more than anyone, has made major contributions both to the theory and computational practice of nonlinear optimization, as well as to their high impact applications to solve a broad range of industrial optimization problems, such as VLSI design, oil and gas reservoir optimization, and electricity networks. The far reaching influence of Andrew Conn’s contributions was felt throughout the workshop. Many speakers highlighted Andy’s impact on their career, and his path-breaking contributions to the field. Many peppered their talks with personal stories and emphasized the social aspects of optimization research, and Andy’s and his wife, Barbara’s role in building the optimization community over the past decades.

The organizers are grateful to the following for their financial support: the Fields Institute, for hosting the workshop and funding speakers and poster presenters from Canada, Europe and Brazil; NSERC, whose academic-industrial collaboration program supported the travel costs of four Canadian speakers as well as the costs of lunch and a reception on the first day of the workshop; NSF, whose funds supported the travel costs of speakers and young poster presenters from the U.S.; SIAM and CAIMS, who supported early-career poster presenters from the U.S. and Canada respectively, and both the University of Waterloo and IBM, whose unrestricted funds supported the travel expenses of Andrew Conn and also distinguished senior researcher John Dennis (Rice University), invited to chair the opening session, and a variety of other expenses, including subsidizing the excellent banquet at Le Select Bistro.

The Organizers:

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