10th PIMS Industrial Problem Solving Workshop
Simon Fraser University, June 26-30, 2006

Contributed by JF Williams

The 10th PIMS Industrial Problem Solving Workshop assembled a group of 65 academics from across Canada, the United States, the United Kingdom, Denmark, Mexico, Singapore, Austria and Australia to work on seven problems submitted by both public and private industry. The workshop was held at Simon Fraser University from June 26-30, 2006, and organized by JF Williams (SFU).

The problems were presented on the morning of June 26. The students who attended GIMMC worked with 20 additional academic participants for the week. Unusually for the conference, seven non-academic participants, representing five of the seven submitted problems, remained onsite at the workshop. Findings were presented June 30.

Applied Innovations: *Scheduling road maintenance procedures.*

Applied Innovations consults with the Government of Saskatchewan on various maintenance issues. They were interested in the best schedule for different road treatment procedures over the lifetime of a road, given that different problems occur at different times and at different rates. The problem was made difficult by noise in both the data on road conditions and the models of wear over time. While working on this problem, the IPSW group managed to prove the theorem "A stitch in time saves nine"! Two employees from Applied Innovations remained at IPSW, and afterwards said they will take back many new ideas.

Aurel Systems: *Numerical solution of multicomponent vapour-liquid calculations.*

Aurel is a small company near SFU that develops simulation and optimization software for manufacturing plants operating in many industries. They brought a seemingly simple problem involving the numerical solution of a small set of nonlinear algebraic equations. However, with discontinuities and non-physical bifurcations, this problem turned out to be surprisingly subtle. The work started at this workshop was sufficiently important to Aurel that the company plans to engage in further collaboration with PIMS scientists.

B.C. Centre for Disease Control: *Determining the impact of a new testing procedure on the spread of HIV.*

A new test for HIV has recently entered the market, one that can determine infection earlier but is more expensive than the test currently in use. The BC CDC wanted a model that would help determine the impact of catching infection in the earliest possible stage (when the carrier is most infectious) in order to evaluate the new test. The problem presenter remained at IPSW for the whole week and had two other colleagues join her on different days. It is expected that this problem will lead the BC CDC to further collaboration with PIMS scientists and possibly to new public policy in B.C.

B.C. Ministry for Advanced Education: *How can we predict future student demand at post-secondary institutions?*

The B.C. Ministry for Advanced Education is responsible for developing and implementing the government's policies for post-secondary education in the province. The ministry came to IPSW with a problem about how to best predict future student demand for university seats, given trends on high school graduation rates and grades. After the presentation, the ministry representative said the work done at the workshop will have an immediate impact in the ministry.

B.C. Ministry of Finance: *Modelling future electricity prices.*

Corporate Finance and Planning is a group within the B.C. Ministry of Finance that determines the financial viability and funding arrangements of future publicly funded projects in B.C. At the moment, the ministry is evaluating a proposal for a new hydro generating station and wanted a new model for electricity pricing in B.C. Most electricity is sold at fixed prices, but the surplus is sold on the open market in Alberta and the Pacific Northwest. Due to data availability, the IPSW group focused on the Alberta market and developed a model that took into account demand not only of electricity but of other resources as well. Most of the work on this problem was done by students who had attended the GIMMC, who had excellent preparation for the challenge.

Prometheus (the Canadian Forest Fire Model): *Improving the numerical simulation of forest fires.*

Prometheus is a group within Alberta Sustainable Resource Development and Natural Resources Canada that provides governmental agencies in Canada with forest fire simulation software. Their code uses local information about topography, fuel type and current conditions to advance a burning front. Their approach has many advantages but also disadvantages related to the topology of the fire's front. The group working on this problem attempted to address both Prometheus' current difficulties as well as proposing a new level set implementation of their model for future work. Two employees from Prometheus joined us for the entire week. The presentation included a working example of the new level set formulation on a model problem, which was very encouraging.

Schlumberger Oilfield Services: *Modelling the release of an encapsulated breaker.*

Encapsulated breakers are used as a cleaning agent in the hydraulic fracture stage of drilling oil wells. The formulation of this product as used by Schlumberger does not behave precisely as the company or the manufacturer expected. In 2002, Sclumberger performed an inconclusive experiment and tasked the workshop with developing a model to explain their observations. A series of potential models were presented and the main result of this investigation was a suggestion for detailed experiments that Schlumberger could perform in order to seek answers.

Detailed problem descriptions are available at http://www.pims.math.ca/industrial/2006/06ipsw/problems.html. Final reports will be available on the PIMS website when they are completed.

All presenters indicated they were very excited about the work done at IPSW. In particular, both Lisa Ransom (Min. Adv. Ed.) and Clare Kirkland (Applied Innovations) said the results were what they had hoped for and would have an immediate impact. Because of the strong involvement by problem presenters throughout the week, the meeting was able to generate considerable knowledge transfer from academia to industry, as well as initiate new collaborations and opportunities for both students and faculty alike.

This year's IPSW has roundly been described as the largest and most successful study group that PIMS has organized. All participants are hoping that next year's event in Edmonton, on June 11-15, 2007, will be even better!