The 8th PIMS-MITACS Industrial Problem Solving Workshop
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The 8th Annual Industrial Problem Solving Workshop, this year sponsored by PIMS and MITACS, came to a successful conclusion at the University of British Columbia on Friday May 21. For the previous four days the group of approximately 80 academics and graduate students had worked on four industrial problems.

Surrey Kim (Random Knowledge Inc., Edmonton, AB, Canada):
Surrey Kim brought a problem relating to network security. Current methods for detecting malicious hacker activity are still in their infancy. Today's methods lack accuracy, speed, and reliability. The approach taken here is to detect malicious activity by identifying anomalous behaviour in otherwise normal network traffic flow. The first task in this problem is to find a mathematical model for normal (legitimate) traffic. In this workshop the group investigated whether normal traffic can be modelled by piece-wise homogeneous Poisson processes.

John Ceko (Husky Injection Molding Systems, Bolton, ON, Canada):
Husky was interested in finding a simplified model of the forces involved in an injection molding machine. In normal operation the piston screw, travelling at a prescribed velocity, impacts molten metal that has been injected into the mold and forces it to completely fill the mold.

Therefore, design features must be specified so that the machine can withstand the repeated stress on the piston due to its impact with the molten metal. In addition, in the event that there is an insufficient amount of material in the mold, the piston may "bottom out". That is, the flange of the piston may impact the housing at full velocity. Currently, the company's analysis of the "bottom out" problem assumes a dry contact between the piston flange and injection housing, when, in fact, there is a thin film of hydraulic fluid between the impacting bodies that will significantly reduce the stress on the system.

A preliminary model which couples the height of the squeeze film with the pressure inside the mold was derived. This provided some information regarding the extent of the stress reduction due to the lubricant. Based on these preliminary results, an improved model that incorporates the hydraulic fluid, the leakage of molten metal past the screw tip and the compressibility of the machine parts and the molten metal is currently being developed.

Kenneth Hedlin (Husky Energy, Calgary, AB, Canada):
The problem presented by Husky Energy concerned seismic attenuation. As an exploration tool attenuation effects have only recently attracted attention. These effects prove useful in two ways: as a means of correcting seismic data to enhance resolution of standard imaging techniques, and as a direct hydrocarbon indicator. In this workshop, attenuation effects such as spherical divergence or scattering were ignored and work was focussed on intrinsic attenuation effects exclusively. The goal of the workshop was to find a means of computing seismic attenuation from relatively short windows of seismic imaging data, and particularly be able to identify regions of anomalous attenuation.

During the course of the workshop the team learned of several techniques currently being used and studied some other possibilities. In detail:
i) An investigation was made of the utility and robustness of using the centroidal frequency and second moment of the frequency over a windowed seismic trace as predictors of anomalous attenuation
ii) Wavelet-based techniques were used to remove reflectivity information from the trace and subsequently extract attenuation information
iii) The Wiener technique was extended to the case with attenuation

In addition to pursuing numerical implementations of the latter two methods, future work regarding this problem will investigate the use of statistical and linear algebraic techniques to retrieve information about attenuation anomalies.

Bill Mawby (Michelin Tire Corp., Greenville, SC, U.S.A.):
Bill Mawby returned with a follow up on a problem treated four years ago. Then the Michelin Tire Corporation proposed a problem on experimental design, to improve the manufacturing process for their tires. The idea is basically to determine the effect of placements for various layers built up in the construction of a tire, to allow the design of a smooth tire with a smooth ride. A highly successful solution was developed, and it has been reported that this method introduced savings of over half a million dollars in their test processes.

This year, Michelin returned to the workshop with an extension to the original problem to address specific refinements in the testing method. The new problem for 2004 was to extend the previous PIMS IPSW 2000 results on Statistical Design in any of several directions including:
i) developing fully the method called the Good Lattice Points (GLP) method suggested in 2000 so that it could be implemented in practice to allow estimation without the prime number restriction,
ii) providing an optimal design strategy given a priori a number of non-harmonic frequency effects and possible ranges for their frequencies,
iii) investigating the ramifications of measuring several different waveforms- for example, one measured radially and one measured perpendicular to the tread, and
iv) expansion of the concept to a two-dimensional Fourier transform or equivalent where the surface could be considered flat or as the surface of an inflated tire (semi-toroidal).

By extending the linear Fourier model developed at the IPSW in 2000, the group was able to make remarkable progress on the four problems, essentially resolving the first three, and suggesting a promising direction to resolve the fourth problem.