Mechanical Engineering

Smooth Operator

by Phoebe Dey

Dr. Ming Zuo makes sure systems are operating as smoothly as possible. That's a simple way of describing the renowned mechanical engineer's work in system reliability—the study of how to ensure a unit runs successfully over a certain period of time.

"The reliability of an engineering system depends on its design, manufacture, operation, and maintenance," says Zuo. "After a system is commissioned into operation, reliability engineers use condition monitoring techniques to assess its health status. The derived health information of the system is then used in making maintenance decisions on when to shut down and replace deteriorated components. You don't want to shut down a machine too early or wait too long for disaster to strike."

Zuo, one of the longest-serving professors in the Department of Mechanical Engineering, runs the U of A's Reliability Research Lab. His projects have ranged from conducting a simulation study of the Edmonton Mail Processing Plant for Canada Post to running experiments on slurry pumps for Syncrude Canada.

During the more than 20 years Zuo has been immersed in reliability research, the trend has shifted towards a philosophy of "asset management." This type of management considers the life cycle of an asset, from conceptual design through to the manufacturing, operational, and maintenance stages.

"This is becoming a critical issue," says Zuo. "You want to fully utilize the investments to get the maximum use out of them. The key questions are 'how long is it going to last, and can you extend its life?'" Because of recent advancements in sensor and information technology, condition monitoring plays an ever more important role in ensuring the reliability of various devices.

Zuo points to the oil sands as an example of where asset management can save the industry money. In one project, he is working with Syncrude to lengthen the life of its slurry pumps. Whenever a pump needs repair, the company must bring in cranes, open the pumps, and replace the failed components. The company ends up having to shut down the pumps for several days, incurring a huge production loss. "To better manage equipment lifespan, we need a way of determining the exact time the pumps need to be shut down rather than relying on a standard

Continued on page 3

Continued from page 1

schedule that may result in a shutdown too early or too late," Zuo says.

"We suggest installing sensors on the pump that could collect such data as pressure, flow rate and vibration. This data will tell you that you might have two weeks left before you need to schedule a repair. That way you're not shutting down prematurely or damaging your equipment by not predicting an imminent failure."

Zuo is also looking to vibration analysis tools to help detect failure in other rotating equipment. Specifically, Zuo and his research team are working on gear boxes that drive conveyer belts in the oil sands. In his lab, he can simulate a crack or wear in gears. He can control for a number of variables and use a vibration-monitoring system to pinpoint the early damage in critical components before the whole system fails.

Companies must currently schedule periodic maintenance repairs because they do not have accurate information on their equipment's health, says Zuo. "Syncrude couldn't tell when the gears were breaking down until the gearbox stopped running. We are in the process of doing experiments in the lab and developing indicators of early damage in gears to help company make effective gearbox operation and maintenance decisions."