

Department of Applied Mathematics and Statistics
The Johns Hopkins University

THE 2007 DUNCAN LECTURE

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Thursday, April 26, 2007
Refreshments: 3:30 p.m.
in 301 Whitehead Hall
Lecture: 4:00 p.m.
in 205 Krieger Hall

AUTOMATIC LEARNING AND MULTI-SENSORS DIAGNOSIS

ABSTRACT

Industrial product quality and machine health monitoring are increasingly automated by real-time analysis of multi-sensors dataflow, the main goals being to detect abnormal regimes, diagnose incidents, and anticipate critical risks.

Multi-sensors dynamics, always influenced by control parameters and environment variables, can very rarely be “explicitly” modeled at reasonable costs. Automatic learning on past sensors dataflow can thus play a crucial role to generate empirical models for multi-sensors dynamics, to compute on-line risk estimates for product quality, or to diagnose machine health incidents.

Fast detection of critical sensors patterns by process operators often relies on their qualitative visual perception of unusual “shapes configurations” in the simultaneous dynamics of a finite family of real-valued curves indexed by time. We will present data-driven empirical modelization techniques which were developed to emulate such implicit “human expert” visual strategies and then applied to industrial multi-sensors contexts: rocket-launching, robotized short-arc welding, car engines vibratory testing, electronic wafers defects monitoring, chemical batches quality estimates, etc.

“Static” learning algorithms and their generalization capacities may rely on mathematical tools such as empirical complexity estimates, improved “support vector machines”, and variables selection by conditional entropy techniques. But on-line decision tools calibrated by automated learning present serious challenges in order to autonomously maintain their pertinence: broad contextual changes and lower performances need to be detected on-line to automatically launch corrective upgrades of the learned “hidden” parameters.

Professor Azencott will give a second lecture on Friday, April 27 at 11:00 a.m. in 101 Shaffer Hall (followed by a luncheon reception at 12:00 noon in 301 Whitehead Hall). The title of his second lecture is “Ultrasound image analysis: Speckle tracking for recovery of cardiac motion.”