ISyE 6810
Systems Monitoring and Prognostics

Instructors

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Course Schedule

Time: Asynchronous
Location: Groseclose 320

Course Overview

The advent of inexpensive sensors, ubiquitous computing and wireless communications have fueled a growing trend of industrial digitization. Transformation initiatives like Industry 4.0 and the Internet-of-Things (IoT) are being embraced by many industrial companies in manufacturing, energy and power generation, oil and gas, mining, logistics, and transportation. Industrial IoT (IIoT) applications generate large amounts of data that can be used to improve industrial operations and processes, assess equipment health and efficiency, manage maintenance and repairs, and provide other valuable insights.

This course focuses on methods and tools used for monitoring and predicting (prognostics) health and/or performance degradation of industrial systems. To this end, the course is divided into two parts. The first part will focus on modeling time-to failure data. We will introduce basic reliability models, parametric and nonparametric estimation methods, and how these methods apply to censored and uncensored data. We will cover Markov models for reliability analysis and its applications in modeling system degradation. We then introduce the proportional hazard model; its basic theory, estimation, and applications.

The second part of the course focuses on condition monitoring data. Unlike time-to-failure data, condition monitoring is the process of using sensor technologies to monitor the health of engineering systems. We introduce basic condition monitoring techniques used in the industrial applications, such as vibration monitoring, infrared imaging, acoustic methods, etc. We cover conventional degradation models used to characterize sensor data acquired using condition monitoring. This will be followed by state-of-the-art degradation-based prognostic models for estimating and updating remaining life distributions of partially degraded systems. The course will cover parametric and nonparametric examples along with Bayesian updating methods that are used for performing on-line model updates.

Grading Policy

1. Exam I – (30%)
2. Exam II – (30%)
3. Semester Paper and Presentation – (30%)
4. Module Quizzes – (10%)

Semester Paper

Student teams will be required to present and submit a semester research paper in which they ***extend state-of-the-art models or develop original modeling frameworks***. The topic and methods used in the paper are expected to be consistent with those studied in the course. Each paper must involve non-trivial data analysis and synthesis. Students are expected to obtain their own sources.

Course References

"Statistical Methods for Reliability Data", by William Q. Meeker and Luis A. Escobar
"Reliability and Maintainability Engineering", by Charles Ebling
"Bayesian Reliability", by Michael S. Hamada, A. G. Wilson, C. S. Reese, and H. F. Martz
"Intelligent Fault Diagnosis and Prognosis for Engineering Systems", by George Vachtsevanos,
"Functional Data Analysis" J. Ramsay and B. W. Silverman
"Functional Data Analysis with R and Matlab", J. Ramsay, G. Hooker, and S. Graves.
"Statistical Inference", George Casella and Roger L. Berger

Honor Code

Students are reminded of the Georgia Tech Honor Code, see http://www.honor.gatech.edu. Any act of dishonesty will result in a Fail Grade.

Students with Disabilities

Georgia Tech offers accommodations to students with disabilities. Please make an appointment with the *ADAPTS* office for specific accommodations (See http://www.adapts.gatech.edu).