

From Condition Monitoring to PHM: The black swan effect and the swan song desire



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Abstract:

Industrial systems can be considered in a system of systems approach and are extremely complex in both their technology and their operation. For the operations and maintenance of such complex assets, a viable solution is to use data science and decision-making processes based on data harvested by pervasive computing.

Industry 4.0 refers to the fourth industrial revolution typified and enabled by instrumentation, interconnection and intelligence. As part of this revolution, maintenance must employ smart systems that predict failure. However, the increasing complexity of assets makes early detection of failure extremely challenging. For complex assets, much information needs to be captured and mined to assess the overall condition of the whole system. Various information on the asset must be integrated to get an accurate health assessment and determine the probability of a shutdown or slowdown. All efforts are focused on the search for the moment just before the shutdown or unexpected stoppage of an asset, or the time of its 'swan song'. Unfortunately, the data collected are not generally sufficient.

The black swan event is a metaphor for an event that comes as a surprise, has a major effect, and is often inappropriately rationalized after the fact with the benefit of hindsight. A key issue is the inability of risk assessment and probability theory to capture extreme events with a very low probability, at least from a data science perspective. This talk includes an in-depth analysis of what a black swan means in relation to asset failure, uncertainty and probability. It explains how the black swan effect in industry may pop up in rare events not considered by data driven models.

The tutorial will address the issues and challenges of data science in industry and transport, emphasizing the positive effects of swan song identification and detection while considering the limitations if black swans are neglected.