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A Case-Study on Optimized Operation and Maintenance of Processes: Conveyor Belt Systems

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Abstract

Conveyor belt systems (CBS) are the arteries of many production lines in process industries and are critical in assuring the material flow between processing units. Disruption of operation due to Corrective maintenance of critical assets such as conveyer belts affects not only the efficiency of the maintenance process, but also the Overall Equipment Effectiveness (OEE) which measures the productivity. Corrective maintenance of conveyer belts also leads to increased costs in operation, maintenance and business processes and reduced system reliability. CBS are used in virtually all process industries, but also other industrial sectors where bulk material must be transported. In mining operations, these systems are present throughout the complete production chain.

It has been seen that insufficient reliability performance of CBS leads to immense losses in costs and operation downtimes. If the conveyor is a crucial bottleneck system, a conveyor breakdown could imply a total stop in the production line. To improve availability and reliability of CBS, proactive maintenance approach needs to be implemented. Implementation of proactive maintenance requires appropriate strategy such as Condition Based Maintenance (CBM) and corresponding technologies for Condition Monitoring (CM). CBM also enables the mining industry to establish an enhanced analytic platform for now-casting and forecasting of asset health (Karim et al, 2016). Enablement of maintenance analytics for CBS, consisting descriptive maintenance, diagnostics, prognostics, and prescriptive maintenance, also helps mining companies to better understand about the condition of their assets, plan necessary proactive actions to reduce the losses, and what affects their degradation. A typical question in that context could be: How to operate the CBS to optimize the remaining useful life while achieving production target?

In order to optimize the operation and maintenance of the CBS a condition monitoring solution need to be in place. Such a solution should not only consider the process dynamics but also the control system and operational conditions, as discussed by Lindström, et. al. (2020). All current approaches usually consider sensor data and data analytics localized to specific components.

In this study, the complete system is modeled including the control system and the interaction with connected systems. The target was then to predict the degradation of a specific component and to relate the degradation to operational characteristics. The resulting approach is depicted in Figure 1. Clearly, all sensor information which is available in-situ is valuable and used together with the process model. A digital twin is composed that has the ability to fuse all the available data from control systems, ERP and IoT systems and provide estimates for the degradation of components in the CBS.

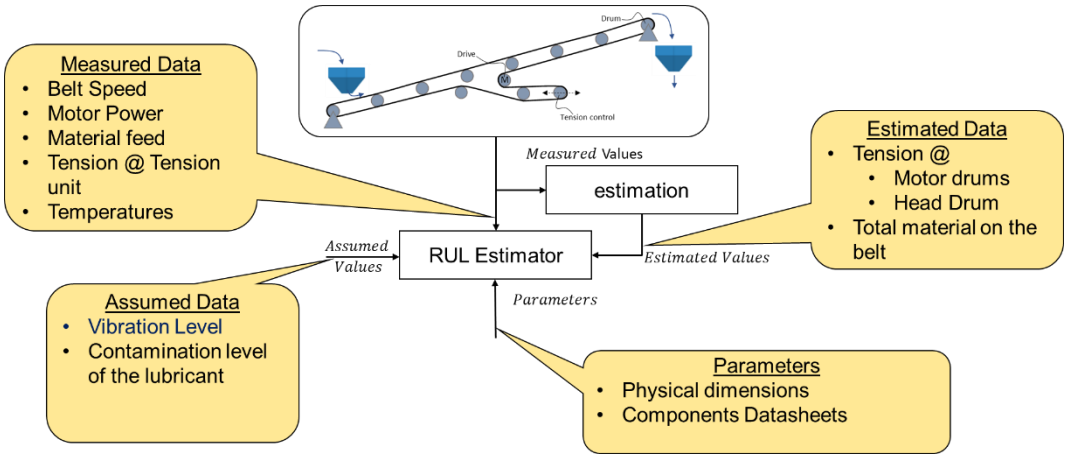

Figure 1: Principle sketch of the Condition Monitoring Approach for a CBS

Based on historic process data, considering maintenance actions and logged events by operator, process engineers, and maintenance engineers, RUL of the Head drum bearings could be predicted sufficiently well, and the approach seems feasible.

From the study it can be concluded that Condition Based Maintenance (CBM) is essential for operation and maintenance of conveyer belts, but it is highly dependent on appropriate technologies for Condition Monitoring (CM). The establishment of enhanced maintenance analytics improves the OEE of the mining industries, but the implementation of enhanced maintenance analytics relies on availability and fusability of data from numerous data sources, e.g. control system, maintenance management system, and enterprise resource planning system. Moreover, estimation of RUL needs to be done context-driven and the optimization of the CBS requires appropriated KPIs, which weigh in operational aspects and maintenance costs aspects. For both asset health and performance monitoring, the KPI definitions are essential.

Future work will expand the approach to multiple components, its validation, and implementation in a service solution.

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