MAKING MAINTENANCE SMARTER – RESEARCH TO INCREASE PROCESS AND EQUIPMENT RELIABILITY

National Institute of Standards and Technology (NIST)

RESEARCH

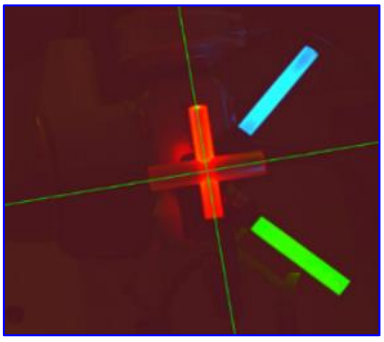
OBJECTIVE - Conduct research to promote the implementation, verification, and validation of advanced monitoring, diagnostic, and prognostic technologies to increase reliability and decrease downtime in smart manufacturing systems.

The below sections present NIST-developed products that are now, or are about to be, publicly-available to enhance manufacturing maintenance practices in support of the above objective. Collaborations with external organizations are encouraged to both speed technology adoption; and improve the quality and relevance of these products and methods.

IDENTIFICATION AND ISOLATION OF ROBOT WORKCELL DEGRADATION

- **Manufacturing Challenge:** It can be costly and time-consuming to determine if the health of a robot workcell has degraded BEFORE quality and/or productivity is impacted.
- **Solution and Resulting Product:** A low-cost, minimally invasive test method to efficiently assess the change in accuracy at various points along the kinematic chain of a robot workcell.
- **Desired Collaborations:** Piloting the test method in a manufacturing environment, to obtain data and feedback for further verification and validation.
- **Collaboration Benefits:** Collaborators can get a first-hand perspective of if, where, when, and/or how the accuracy of their robot workcells degrade PRIOR to unacceptable quality and/or productivity losses.

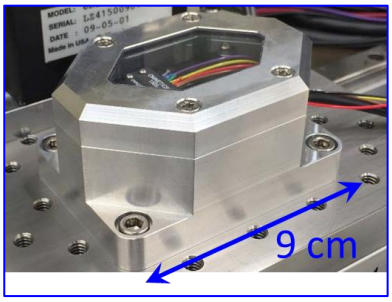
ASSESSMENT OF ROBOT ACCURACY DEGRADATION



- **Manufacturing Challenge:** Degradation of a robot's accuracy can compromise the efficiency, quality, and productivity of a manufacturing system. Robot accuracy degradation is relatively difficult to detect when compared to a failure that halts an entire operation.
- **Solution and Resulting Product:** A quick health assessment methodology to enable manufacturers to assess a robot's tool center accuracy degradation in as little as 10 minutes by determining the robot pose deviations from the nominal poses after the robot performs a series of pre-programmed moves.
- **Desired Collaborations:** Further develop appropriate manufacturing use cases and pilot the quick health assessment methodology for further verification and validation.
- **Collaboration Benefits:** Collaborators can monitor the degradation of robot performance to better understand the impact their specific processes have on robot health. This newly-acquired intelligence can lead to reduced downtime.

FOR MORE INFORMATION, PLEASE CONTACT – maintenance@nist.gov

Monitoring Linear Axes with an Inertial Measurement Unit (IMU)

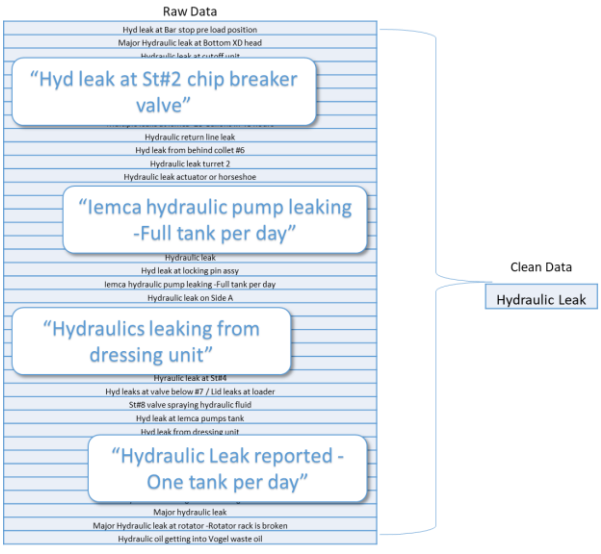


- **Manufacturing Challenge:** Machine tools are vital for production, but wear causes unknown performance changes and unplanned downtime. This leads to the question of capturing machine health in a short amount of time -> "Machine health in 5 min?"
- **Solution and Resulting Product:** On-machine measurement science, via sensors & data analytics, to diagnose performance & root causes of faults.
- **Desired Collaborations:** Piloting a sensor-based unit in a manufacturing environment, to obtain data and feedback for further verification and validation.
- **Collaboration Benefits:** Knowledge of changing linear axis performance to maintain part quality and prevent unplanned downtime.

Economics of Advanced Maintenance

- **Manufacturing Challenge:** There is limited knowledge on the costs and benefits of implementing advanced maintenance technologies and practices.
- **Solution and Resulting Product:** Combine public data with survey data to present a more comprehensive business case for manufacturers to invest in advanced maintenance capabilities. This will lead to the inclusion of manufacturing maintenance data in the NIST-developed "The Manufacturing Cost Guide" that will be publicly-available.
- **Desired Collaborations:** Participate in the NIST-driven manufacturing maintenance survey.
- **Collaboration Benefits:** Collaborators can increase the ease of developing the business case for advanced maintenance practices in manufacturing.

Knowledge Extraction and Application of Maintenance Work Order Data



- **Manufacturing Challenge:** Maintenance work orders often provide a rich source of unstructured maintenance data filled with jargon, abbreviations, short-hand, yet there is a lack of simple solutions to analyze this data.
- **Solution and Resulting Product:** A free, open-source natural language processing tool kit for processing maintenance work order data.
- **Desired Collaborations:** Pilot the natural language processing tool and subsequent analysis in a manufacturing environment, obtain data and feedback for further verification and validation.
- **Collaboration Benefits:** Collaborators can obtain a preliminary analysis on their maintenance data and can help contribute to improve the tool and analysis methods

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