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Studienarbeit (Mechatronics)

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Title: Synthetic Data Generation for the extension of degradation index from run-to-failure tests to compensate for missing data.

One of the primary challenges encountered with run-to-failure measurements for any component is the lack of data about the actual failure event. This issue arises from the industry practice of replacing critical components before they fail, a preventive measure to control material costs and avoid unplanned downtime. As a result, only incomplete time series data for a component's entire lifetime is available, which can hinder the development of accurate remaining useful life (RUL) prediction models.

Proposed Solution:

Implement Generative Adversarial Networks (GANs) / Recurrent Neural Networks (RNNs) or other time series data generation models to generate realistic degradation trajectories for the given component from the point of their replacement to the hypothetical failure point. These models should be able to learn the underlying patterns in the available degradation data and generate plausible future sequences, effectively filling in the gaps and providing complete run-to-failure data. This approach can improve the performance of RUL prediction models by providing them with more comprehensive training data.

Hence, the proposed student project includes the following steps:

1. Literature Review: Conduct a comprehensive review of existing literature on handling missing data and the theoretical basis of GANs, RNNs, and other relevant time series models.
2. Data Collection and Analysis: Conduct exploratory analysis of component degradation data.
3. Model Selection and Design: Choose an appropriate model (GAN, RNN, etc.) and design its architecture to fit the project's needs.
4. Implementation and Training: The model should be designed using suitable machine learning frameworks (MATLAB or Python).
5. Synthesis of New Data: Determine a suitable failure point and generate realistic time series data from the point of component replacement to the hypothetical failure point.
6. Model Testing: Compare and test the model with the experimental data for model improvement.
7. Documentation and Presentation: Comprehensively document the project process and results in a report.

The ability to work independently and meticulously is essential. Proficiency in using machine learning models and digital signal processing is a distinct advantage. For further clarification, please get in touch with the individual listed above. The work can be conducted in German or English. It should be noted that specific conditions for the working group and examination office within MSHM must be observed.