Master Project

Fault Isolation for High Precision Motion Systems

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Context

Nowadays, high-tech industry depends a lot on advanced machinery that functions within high precision requirements. Downtime of machinery is very costly, so reducing it as much as possible can be very beneficial for the industry. One solution to this problem is the use of fault diagnosis methods. Fault diagnosis is the process of identifying and isolating faults in a system by analyzing its behavior and symptoms. Accurate and timely fault diagnosis help also reduce downtime, improve efficiency, and increase the overall reliability of systems and equipment.

Figure 1: The AB383 wirebonder system.

Project

This project is about the design and implementation of a fault isolation system for the AB383 wirebonder, figure 1, designed and manufactured by ASM Pacific Technology. The wirebonder is used in the electronics and semi-conductor industry and it creates connections between integrated circuits (IC's) and its packaging. The motion subsystem from the wirebonder is shown in figure 2. Several faults can occur due to extensive use, and a fault isolation system is responsible for determining which fault is happening. The most notable faults are an increase in friction, the degradation of the motor force, a decrease in structural stiffness and the presence of external disturbances. For the analysis and the simulation of the different faults we have access to a Simscape Multibody™ model of the system.

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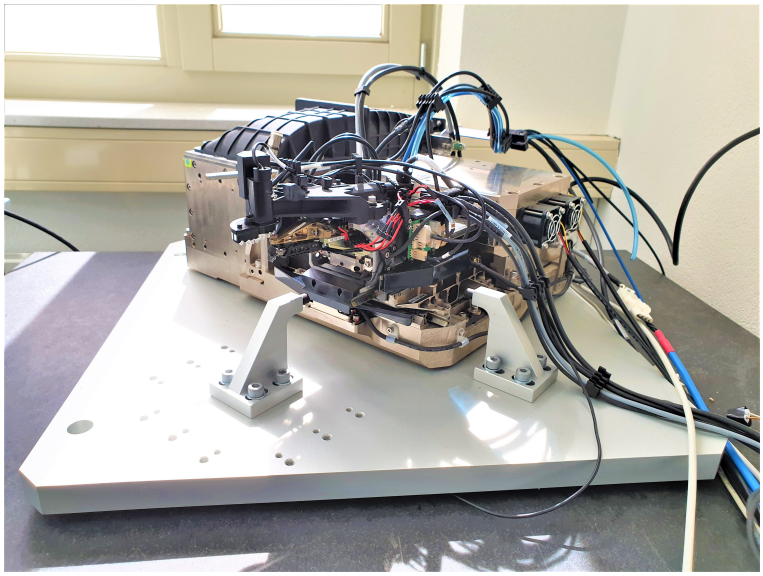

Figure 2: The XYZ-motion stage of the wirebonder.

Method

Over the past several decades, a wide range of fault diagnosis methods and techniques have been developed and applied in various contexts. For this specific problem both a simulation model and an abstract model of the system are available. For these reasons we have decided that the direct filter method is the most suitable for the fault isolation filter. This method is a model-based fault diagnosis method shown in figure 3. It provides flexibility, generality and insight in comparison with other fault diagnosis methods discussed. Moreover, it can handle the model mismatch between the mathematical description and the simulation model. We will focus on obtaining signals known as residuals. A residual is the difference between the predicted output of a system and its actual output, used to identify and diagnose faults in the system. These residuals will be processed and analysed to determine whether a specific fault is present in the system.

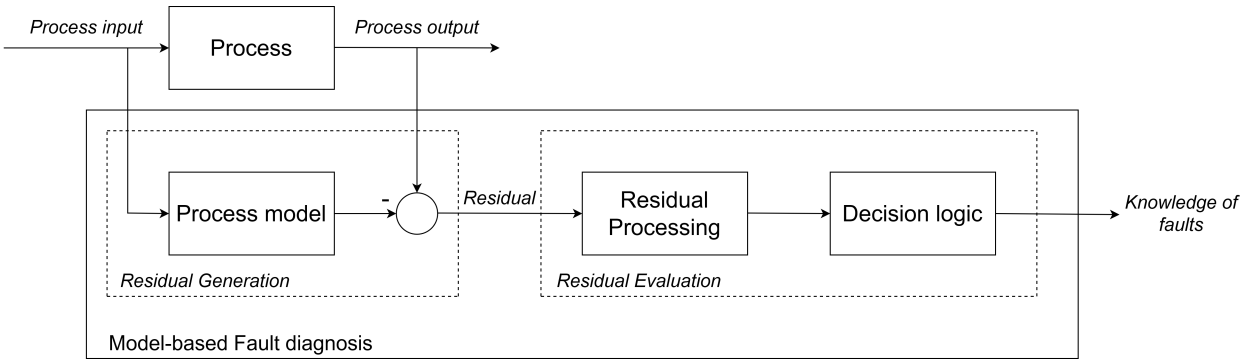

Figure 3: The Model-Based Fault Diagnosis scheme.