Dynamic Gaussian mixtures to modelyze and correct the Scan-Time in PLC's. Application in Miniterm 4.0

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Abstract

The present work showss the mathematical model of a phenomenon that occurs when minterms are measured at an industrial level, known as "Scan-Time". The minterms are the indicator that allows the miniterm 4.0 system predict if the component of a machine is close to suffering a failure or breakage. The minterm is based on the measurement of the sub- cycle time of each component, that is, the time that each component needs to do its task [1], [2]. When the system detects a deviation from the normal values, it generates an alert that allows to anticipate a failure and therefore an unwanted production stop. There are currently 20,000 components and machines measured at the Ford Almussafes factory using this technology,[3] .

One of the industrial advantages of the minterms is that it does not need installation, since it uses the sensors and devices already installed in the production line. One of these devices is the PLC (Programmable Logic Controller). The PLC is programmed using grafcet that models the operating logic of the production line. the way a PLC works is simple. First, read the inputs, run the program, and update the outputs to govern the line.The minterm is measured by a timer, measuring the elapsed time between two discrete events, mainly inputs of the PLC. The elapsed time between read the inputs, run the program and write the outputs is known as Scan-Time. This time may vary depending on the PLC program and its load. The scan time affects the minterm measurement, introducing a perturbation that should be eliminated to improve the efficiency of the algorithms that uses this data. The objective of this article is to mathematically model the effect of the scan-time using a Dynamic Gaussian mixture models to detect and measure the scan time effect in a set of data and to obtain the true value of the minterm. At the end of the article, real cases will be presented to validate the model and the correction.

References

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