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Confidence Machine Learning for Cutting Tool Life Prediction

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Abstract

The work aims to develop an automatic cutting tool life prediction model for die-cuts machine at Parafix. Such model will be able to estimate how long a given tool is likely to last, in order to improve performance and productivity. This work is part of the KTP project between Parafix and University of Brighton.

Keywords: Tool life prediction, Conformal Clustering, predictive maintenance.

1. Introduction

Parafix is a long established UK based converter and distributor of self-adhesive tapes, foams, films and other flexible materials, creating complex, bespoke adhesive components for a number of market sectors. One of the challenges for Parafix is understanding maintenance scheduling and machine failure, which have previously occurred mid-job where the cutting tool broke down and subsequently required jobs to be rescheduled, impacting on delivery times.

Therefore, this project aims to utilise the input data from the recently installed pressure sensors on the die-cut machines, along with the material types and the product geometries, to develop an automatic tool life prediction model, while addressing the problem of sensor noises.

2. Sensor input data

The training samples come from an industry grade miniature load cell (see Figure 1), designed to operate in confined space. This load cell measures the pressure (in PSI unit) being applied by the operator on two separate points (i.e., near side and gear side) on both ends of the die-cutting machine, holding the cutting tool in place. The sensor has a sensitivity of 2.0 mV/V, a sampling rate of 9,000 Hz, and can withstand up to 2,250 PSI (158 kg/cm^2).

However, the challenge for using such sensor is the high electrical noise (see Figure 2) at up to 12 PSI (0.8 kg/cm^2). Therefore, there is an urgent need to develop a robust Machine Learning model that can handle such uncertainty.

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