Fully automated quality check spots faulty electric motors

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Video Abstract

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Abstract

A new, fully automated approach could help spot faulty electric motors before they leave the production floor. Based on a popular machine-learning algorithm known as an autoencoder, this technique could prove invaluable to the numerous industries that produce electric motors, as well as those that rely on them. An autoencoder is an algorithm that distills, or encodes, input data down to a few key elements. It then decodes that information to reproduce the original data as closely as possible. At first glance, it might look like a simple cut-and-paste operation. But there's more than meets the eye. The algorithm actually learns to pick out patterns that are fundamental to the structure of the original data set. For that reason, the tool is incredibly useful for cleaning up noisy data. Trained on a sufficiently large data set, an autoencoder can look at a muddled image and output a fair restoration. That ability, it turns out, is also valuable for telling a good electric motor from a bad one. Researchers from Italy trained three types of autoencoders to learn the features that define a normally operating electric motor: multilayer perceptron, convolutional network, and recurrent autoencoders. As input data, they used more than 1000 vibration signals gathered from electric motors run on a measuring station. It's the type of quality check normally performed by human operators at the end of a production line. They then tested the autoencoders on data from a mixture of faulty and normal motors. The goal was to distinguish one group from the other. The team's results showed that the multilayer perceptron, or MLP, autoencoder was the best classifier. Where a perfect classifier shows a classification quality of 100%, the MLP algorithm achieved a score of over 99%. The recurrent algorithm came in a close second. And the convolutional neural network algorithm and a separate state-of-the-art classifier lagged farther behind. The findings hold important implications for the automotive and information technology industries, two of the biggest producers of electric motors. Without the burden of human error, this fully automated system could help boost efficiency and overall output. The team plans to expand their approach to different types of motors and generators as well as to different types of classification algorithms.