Acoustic array data processing for AI
An application for condition monitoring using machine learning

L.A.L. Janssen, I. Lopez Arteaga

Introduction
The vast majority of work on artificial intelligence in the field of condition monitoring is based on sensors collocated in the machines. However, the possibility of using acoustic arrays as a non-intrusive contact-less sensor is emerging. This poster shows a novel method to localize disturbances in dynamical systems using acoustic arrays by processing their data such that common artificial intelligence techniques can be used. The acoustic array data is compressed into spatial- and frequency-domain based 3D images. The proposed method has been demonstrated by localizing a disturbance mass on a vibrating brass plate using a 32 by 32 microphone array. The experiments show promising results for applications where space-frequency information is of essence.

Experiment
In order to validate the method, a data set is created of experimental data from a 32 by 32 microphone array that measures the acoustics of a vibrating brass plate with a disturbance mass located in different positions (Fig. 1). The data set is used to train an AI to predict the location this mass based on the measured acoustics.

Method
The microphone array data is compressed firstly by taking the Fourier transform per microphone. Consequently, spatial images for an equally distributed range over the relevant frequencies are acquired. This data is reshaped into a 3D input $[\text{freq} \times \text{x} \times \text{y}]$ for a simple neural network in Keras [1] that is designed for robustness and testing methods (Fig. 2).

Results
The results (Fig. 3) show that, in most cases, the trained neural network is able to predict the location of the mass with low amounts of training data (4 training samples per mass position) with a test error $< 8 \text{mm}$.

References