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COMO1#3 - Bearing diagnostics and speed estimation via smartphone standalone data

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Condition monitoring of rolling element bearings is a point of interest for early damage detection and prediction to avoid unexpected rotating machinery breakdown. Rolling element bearing related signals are often acquired with accelerometers, as vibration signals usually carry sensitive early information related to the bearing damages. However the accelerometers need to be physically mounted in contact near the bearing to be monitored. Acoustics signals from microphones provide an alternative solution as they acquire signals from multiple sources and bearings, without needing to be in contact with the bearing housing. Accurate speed estimation is also a necessity for detection of the bearing damages, as the bearing related frequencies are dependent of the shaft speed. Encoders are then needed to be added during design phase and mounted to the drivetrain, or a zebra tape and optical tachometer are glued and mounted on one shaft of the drivetrain to properly extract the speed signal. The goal of this paper is to propose using a smartphone instead of expensive measurement equipment and data acquisition systems can result in a fast and cost-effective methodology to monitor the health status of rolling element bearings. The shaft speed extraction is based on video images acquired by the smartphone camera. This methodology exploits the deformation of the video image due to the rolling shutter effect of the smartphone camera. The bearing damage detection is based on the audio of the smartphone video. The audio is captured in stereo by a dual plug-in microphone. The speed estimation via video and signal processing methodologies proposed for bearing diagnostics are applied on real data from an experimental drivetrain different cases of damaged bearings running at shaft speeds in the range from 5 to 40 revolutions per second.

Presenter(s) : MAURICIO ALEXANDRE

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