Assessment of harmonic suppression methods within OMA of an axial piston pump under constant speed

Vijayasankar Irissappane[*†1], Christian Svendsen[2], and Luis David Avendaño-Valencia

[1]University of Southern Denmark – Denmark
[2]Danfoss A/S [Nordborg] – Denmark

Abstract

Operational Modal Analysis (OMA) is a widely used technique for modal parameter identification from in-operation data. OMA on rotary machines like Axial Piston Pumps (APPs) is challenging due to the presence of strong harmonic components. In this study, OMA is applied to an APP running at constant speed and constant pressure conditions. Time-domain vibration data from the pump are preprocessed using cepstrum editing and time synchronous averaging (TSA) to suppress deterministic harmonics from rotation and pumping. Frequency Domain Decomposition (FDD) and Stochastic Subspace Identification (SSI) algorithms are applied to extract modal parameters. The results demonstrate that although FDD-based methods are computationally efficient, they require domain knowledge and manual interpretation of peaks, thereby complicating the process. The SSI algorithm, while generally considered more robust, had challenges in identifying the modal parameters as well. The preprocessing techniques improve the performance of OMA algorithms by suppressing the effects of the harmonics present in the measured signals, but it does not remove them completely. This paper concludes with discussions on the implications of these techniques for structural health monitoring (SHM) and future work.

Keywords: Operational Modal Analysis, Frequency Domain Decomposition, Stochastic Subspace Identification, Axial Piston Pumps

*Speaker
†Corresponding author: viris@sdu.dk