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CFD-Machine Learning Tilt Pad Bearing Software, 00147

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Thermal mixing in a groove region between pads is an essential factor for the rotor-dynamic coefficients of a tilt pad journal bearing because it impacts heat transfers to the rotating shaft and bearing. The thermal design of the rotating machinery equipped with the hydrodynamic bearings, based on the flawed groove model, may cause the unexpected maintenances of a rotating machine by rotor instability or surface material melting, which invokes wasting cost. However, despite the importance of the groove model, conventional models have been over-simplified by an uncertain parameter called the mixing coefficient. Also, a reliable 2D temperature distribution effect has not been considered at a circumferential groove outlet.

In order to overcome the drawbacks of the conventional models, new software has been developed with a surrogate groove model via a deep convolutional autoencoder neural network based on CFD (Computational Fluid Dynamics) data. The trained Convolutional Neural Network (CNN) shows excellent prediction capability for the dynamic coefficients with exact 2D temperature distribution prediction at pad leading-edges of thin-film. In the developed software, the trained CNN is combined with a rotor-bearing model, which has the Thermo-Elasto-Hydrodynamic (TEHD) prediction capability. The combined model is verified by full CFD results and experimental data. In addition, the developed software is used to carry out thermal analysis and dynamic coefficient prediction for the rotor-bearing systems with various oil injection types while investigating the dynamic coefficient effect and heat transfer mechanism to the rotating shaft and bearing. The superiority of the new software has been proven via thorough comparisons with the modeling approaches reported in recent literature.