Case Study

ANSYS® + Robert Bosch Engineering & Business Solutions

"In typical fluid power applications, vapor formation and implosion due to cavitation is one of the major threats in reducing the aggregate efficiency of the system. Hence, it is imperative to have a deep understanding about the formation and effects of cavitation, which will directly influence the reliability of a fluid power system. ANSYS Fluent multiphase capabilities are used for vane pump design optimization, especially for cavitation reduction. The multiphase simulation helped us to reduce the time period for a prototype design."

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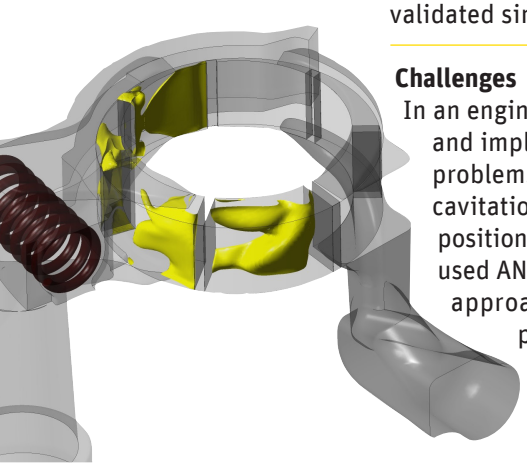
ANSYS

Robert Bosch Engineering & Business Solutions

Development and Validation of Simulation-Based Design Optimization Process for Engine Lubrication (Vane) Pump



A multiphase simulation was performed of an engine oil lubrication vane pump. Cavitation becomes more harmful when the vapor bubbles move toward a high-pressure zone inside the pump, causing implosion and shock waves. Moreover, cavitation formation reduces the pump's efficiency, which is directly interconnected with the engine's lubrication and fuel efficiency. The objective was to identify the zones that are prone to cavitation using a validated simulation approach.

Challenges

In an engine lubrication pump, vapor formation and implosion due to cavitation is a major problem. Direct experimental detection of cavitation is impossible due to difficulties in positioning sensors. Instead, Bosch engineers used ANSYS Fluent as part of a CFD simulation approach to predict the cavitation-prone regions and their influence on the volumetric efficiency of a vane pump. The focus was on pump behavior at critical low temperatures, where cavitation is prevalent.

Technology Used

ANSYS Fluent
ANSYS Meshing
ANSYS Workbench
ANSYS CFD-Post

Engineering Solution

- The classical boundary condition of high pressure at the outlet of the vane pump was replaced by modeling the orifice at the pump outlet. The orifice model included the hydraulic resistance produced by engine permeability and auxiliary components placed between the pump and engine.
- The simulated pressure peaks at different operating points were validated against the trend of experimentally observed pressure peaks from a test bench, with less than 12 percent deviation.

Benefits

- Prediction of cavitation-inducing regions using simulation helped engineers to produce a flawless design on the first iteration.
- An overall time reduction of about 35–38 percent was achieved using simulation to finalize the design of the engine lubrication pump.

Company Description

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