Dissertation Defense

Agricultural & Biological ENGINEERING

Marco was born in Guastalla, Italy. He received his B.Sc. and M.Sc. degrees in Mechanical Engineering at the University of Parma, Italy, with specialization in Energy conversion systems.

After one year of fellowship at the University of Parma, working on modeling of external gears machines, Marco joined the Maha Fluid Power Research Center in May 2010 as PhD student, under the supervision of Dr. Monika Ivantysynova.

Marco's main interests are in the numerical modeling of elasto-hydrodynamic and thermal effects in the main lubricating interfaces of positive displacement machines, with main focus of axial piston units.
His research is partially founded by a NSF founded Engineering Research Center, the Center for Compact and Efficient Fluid Power (CCEFP), project 1B.1 and supported by a number of industry projects.

Marco shared his research findings in eight international conferences on Fluid Power technology around the world during his almost four years at the Maha Center. It is author of ten conference papers, some of which were peer reviewed and is currently working to submit two papers on international journals.

Speaker: Marco Zecchi

Title: A Novel Fluid Structure Interaction and Thermal Model To Predict The Cylinder Block / Valve Plate Interface Performance In Swash Plate Type Axial Piston Machines

Major Professor(s): Dr. Monika Ivantysynova

Date: Thursday, November 21, 2013

Time: 3:00PM

Location: Maha Fluid Power Research Center.

1500 Kepner Dr., Lafayette (IN), 47905.

Abstract:

The cylinder block / valve plate interface represents one of the most critical design element in the rotating kit of axial piston machines. The thin fluid film of lubricant between cylinder block and valve plate has to fulfil simultaneously a bearing and a sealing function under dynamic load conditions; on the other hand, it represents an important source of power losses due to viscous friction and leakage flow. An accurate prediction of the time changing characteristics of the lubricating interface, in terms of fluid film thickness, dynamic pressure field, load carrying ability and energy dissipation is necessary to generate more efficient and reliable designs. The aim of this work is to deepen the understanding of the main physical phenomena affecting the cylinder block / valve plate interface performance. For this purpose, a unique fully coupled multi-body dynamics model has been developed to capture the complex fluid structure interaction phenomena affecting the non-isothermal fluid film conditions. The model was validated by comparing the predicted surface temperature of the valve plate with measurements for two different machines, a 100 cc and a130 cc units of commercial production. In the first case the measurements were available in literature, in the second case an specific test stands was developed as part of the experimental study of the present work. The model has also been successfully applied to the study of the impact of micro surface shaping on the performance of the cylinder block / valve plate interface.

Application:

Although the developed model has been developed for to the cylinder block valve plate interface of axial piston pumps and motors, the same approach can be applied to many of the lubricating interface in positive displacement machines like bent axis, radial piston, external/internal gears. The Also many others mechanical engineering fields where