XXV Congresso de Iniciação Científica da Unicamp
October 18 to 20 Campinas | Brazil
2017

Flexible coupling model in rotor-bearing systems (FEM convergence analysis)

Caio G. Schoola, Katia L. Cavalca, Felipe W. S. Tuckmantel

Abstract
Study of mesh convergence of a mechanical flexible disc coupling modeling.

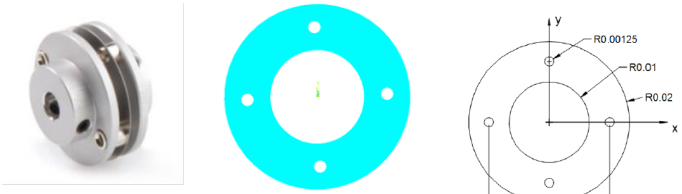
Key words:
flexible coupling, FEM, mesh convergence analysis

Introduction

This proposal aims to analyze the mesh convergence of the mechanical flexible disc coupling and guarantee acceptable convergence without high costs of processing. In order to analyze its convergence, there are some important output data from the Ansys modeling, such as: Von Mises Stress; Stress in X-Y-Z axis; Displacement (Z axis). This study focus on the Z axis displacement.

Results and Discussion

There are two types of disc couplings: Single disc and Double disc (Image 1(a)). A mechanical flexible single disc coupling is composed by a flexible disc and two hubs. As modeling parameter, it is considered that the two hubs (shaft connectors) don't contribute to the disc coupling stiffness. The stiffness of a disc coupling mainly results from the elastic energy absorption of the center disc (Images 1(b) and 1(c)). Therefore, a convergence analysis initially studies the modeling of the central flexible disc by FEM. The disc of interest has four connecting points, two for each hub, and a center orifice.



(a) (b) (c)

Image 1. (a) Mechanical flexible single disc coupling; (b) Disc geometry and (c) Dimensions [m].

To study the convergence, an angular displacement of 1º (0,0175 rad) is applied on the X axis and the holes on the X axis are set to null conditions. It is also proposed a meshing region separation in order to control some parameters of the meshing tool. It is possible to analyze the results by changing finite elements geometry, number of elements and their disposal (creation of smaller regions to limit the meshing and parameters) as in Image 2. Analyzing the Z displacement convergence, it is possible to verify the relation between number of elements and the error associated with the displacement.
The error analysis (Image 3) comes from comparing the each result with the mesh with lower sensitivity, set as a reference (100197 elements).

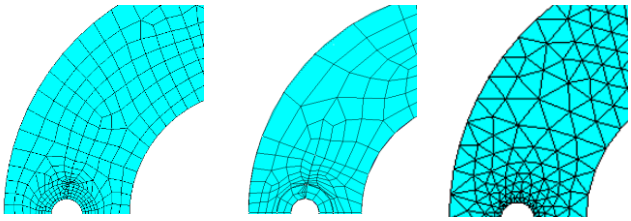


Image 2. Meshing parameters.

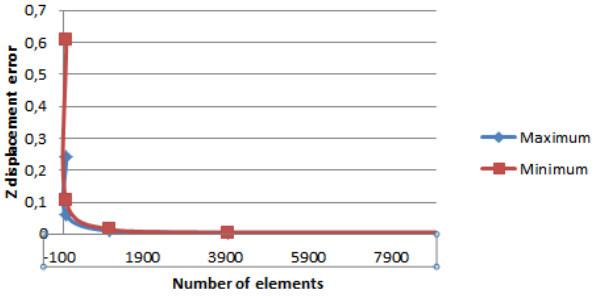


Image 3. Error analysis.

Conclusions

A reference mesh with high complexity of elements (highest number of elements and nodes) is not necessary to well describe the FEM model, regarding Z displacement. Good results and viable processing cost con be reached around 2000 elements. Then, it is possible to find a viable mesh to work with and stay having good results. It is important to point out that the best mesh depends on the design purposes, since the convergence of different parameters is not the same.

Acknowledgement

The project is funded by FAPESP, process number #2017/04482-0 and #2015/20363-6.

MANCUSO, Jon R. **Couplings and Joints: Design, Selection & Application**. CRC Press, 1999.

BITTENCOURT, Marco Lúcio. Introdução ao método de elementos finitos aplicado à análise estrutural–exemplos com o programa Ansys. **Campinas: Unicamp**, 2007.

OTSUBO, Gabriela Mayumi de F. Modelos de acoplamentos flexíveis em sistemas rotor-mancais. Trabalho de conclusão de curso. **Campinas: Unicamp**, 2016.