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FÖR HÅLLBAR VATTENKRAFT

# Models for mechanical analysis generators with floating rim

## Objectives and Goals

### Main objectives

- Comparison of two- and three-dimensional generator model
- Simulation of short circuit
- Determine critical components for different load cases.

### How the project supports sustainable hydropower

By dynamic analysis vibration and catastrophic failures can be avoided.

### Impact or innovation

Three-dimensional analysis of generators has not been performed earlier, and the main problem is to connect the forces between rotating and stationary parts. With a three-dimensional model, stress and strain can be analyzed on component level. A two-dimensional model has been developed earlier, which can be used for fast simulations. By comparing it with a three-dimensional model the limitations of the two-dimensional model can be analyzed.

### Research Question

- How can a flexible hydropower generator be characterized to facilitate dynamical analysis?

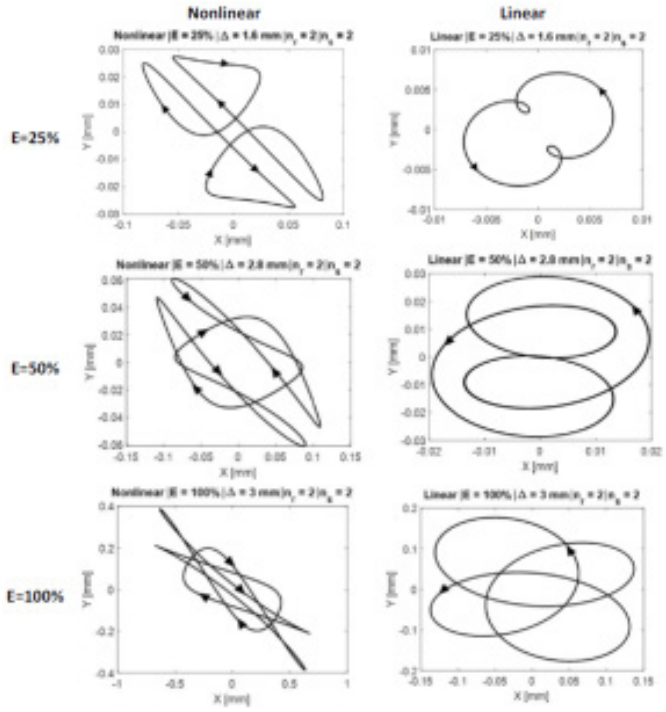


Figure 1 Comparison of orbits for Oval Rotor (nr=2) and Oval Stator (ns=2) using the linear and nonlinear radial magnetic force model.

## Key Results

- Result 1: Effects of nonlinear magnetic pole force on the dynamics of hydropower generators. It is shown how dynamics differ between linear and non-linear models for large eccentricities.

- Result 2: A three-dimensional model is created for a hydropower generator for dynamic analysis. With a three-dimensional model stress and strain can be analyzed in detail.

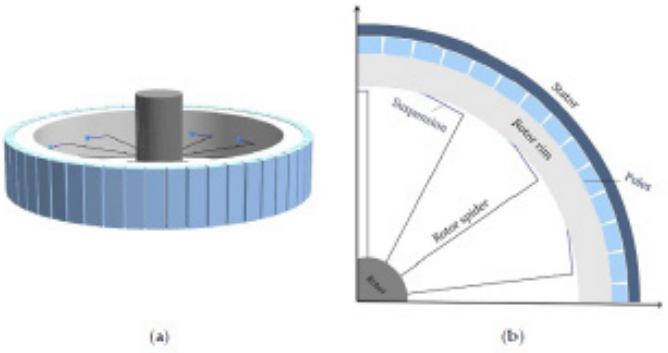


Figure 2 (a) Overview of the Finite Element model. (b) Components of the model.

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## Publications / Outputs

**In a previous project**

A Rotordynamic Characterization of Tilting-Pad Bearings With Eight Pads in Vertical Rotors. Authors: David Rondon, Gudeta Berhanu Benti, Jan-Olov Aidanpää and Rolf Gustavsson. Journal of Energy Resource Technology (2022)

Numerical and experimental study on the dynamic bearing properties of a four-pad and eight-pad tilting pad journal bearings in a vertical rotor. Authors: Gudeta Berhanu Benti, David Rondon, Jan-Olov Aidanpää and Rolf Gustavsson. Published in Journal of Energy Resource Technology (2022)

Dynamic model for hydropower generators with floating rotor rim. Authors: David Rondon, Jan-Olov Aidanpää, Rolf Gustavsson, Urban Lundin and Peter Jeppsson. Published in Mechanical Systems and Signal Processing (2023)

**In this project:**

Effect of unbalancing mass placement in hydropower generators with floating rotor rim. Authors: David Rondon, Jan-Olov Aidanpää and Rolf Gustavsson. Published in IOP Conference Series: Earth and Environmental Science (2022)

Effects of nonlinear magnetic pole forces on the dynamics of hydropower generators with floating rotor rim. Authors: David Rondon, Jan-Olov Aidanpää and Rolf Gustavsson. Published in a book,16th Chaotic Modeling and Simulation International Conference / [ed] Christos H. Skiadas; Yiannis Dimotikalis, Springer Nature, 2024, p. 541-552.

Three-Dimensional Modeling for Mechanical Analysis of Hydropower Generators with Floating Rotor Rim. Authors: David Rondon, Simon Pääjärvi, Jan-Olov Aidanpää, Rolf Gustavsson and Peter Jeppsson. Published in MDPI Machines (2024)

## Future work

• The project is finished but we will solve the short circuit question during 2025

## Training/capacity development

• Presentations in SVC reference group
• One PhD student
• Presentation at two scientific conferences
• Presentation at SVC hydropower day
• Presentation at "Svenska Mekanikdagarna" 2022

## Project

Models for mechanical analysis generators with floating rim
Duration of project: 2023(January)-2024(June)

## Project Leader

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## Team Members

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## Partners

Vattenfall VRD, LTU, VOITH and UU