Master’s thesis

At ARotor

Aalto University, Finland

Aalto-yliopisto
Aalto-universitetet
Aalto University

Topics

See the detailed topics:
https://tinyurl.com/AROTOR

1. **Black-box modelling of powertrain components**
2. **Identification of powertrain parameters**
3. **Modeling the runnability of a paper machine**
4. **Development of sensor for on-line measurement of paper thickness**
5. **Development of internal multi-probe roundness measurement device**
6. **Air bearing journals for test rotor**
7. **Dynamics of aerostatic seals**
8. **Implement gear failure test setup to a scaled down marine propulsion powertrain**
9. **Development of an IoT battery powered torque sensor**
10. **Charging of wireless on-shaft sensor**

1. Black-box modelling of powertrain components

Dynamic model sharing is an emerging trend linked to the digitalization of industry. In this topic, methods for black-box modelling of powertrain components, such as electric motors and gears.

- **FMU/FMI, time and frequency domain analysis**
- **Combine skills in electrical and mechanical modelling**
- **Black-box models of products can be supplied alongside real products for increased benefit**
- **Work on the newest technologies in computational engineering**
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Source: Wikimedia commons

2. Identification of powertrain parameters

Commissioning and design of powertrains can be made easier with automatic tools for model parameter recognition. In this topic, different methods for identifying mechanical parameters are evaluated.

- ***Literature research on parameter identification methods***
- ***Design and implementation of chosen methods with reference measurements at ARotor laboratory***
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3. Modeling the runnability of a paper machine

Predict the output quality parameter (such as thickness variation) in a production line based on all the available data.

- **Cardboard, paper, plastic film and steel production processes**
- **Relate product line data to measured quality parameters**
- **Use ML (deep learning) or other AI techniques**
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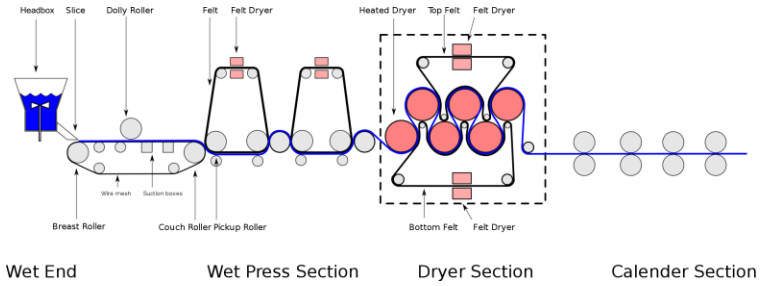

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4. Development of sensor for on-line measurement of paper thickness

Accurate offline technologies exist for the measurement of paper or cardboard thickness. Investigate possibilities of new sensor technologies for in-process (on-line) thickness measurement

- ***E.g.*** **confocal, blue laser triangulation and others**
- **Use existing laboratory sensor technologies as reference**

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TAPIO® Paper Machine Analyzer V2 (for offline measurement)

5. Development of internal multi-probe roundness measurement device

Multi-probe roundness measurement methods can be used to determine the roundness profile accurately even when the system exhibits unrepeatable center point motion. Develop and construct a multi-probe roundness measurement device for measurement of internal surfaces.

- ***Design of new measurement device***
- ***Applications in tube roll manufacturing research***

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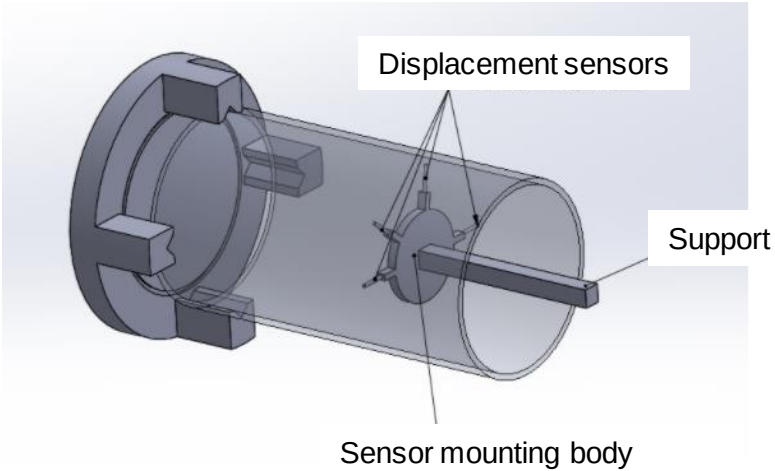

6. Air bearing journals for test rotor

Aerostatic bearings enable accurate motion with low friction. Implement aerostatic bearings for test rotor system.

- **Design and implement aerostatic journal bearings for a 740 kg test rotor**
- **Current bearings are roller element based**
- **Investigate the dynamics with traditional and aerostatic bearings**
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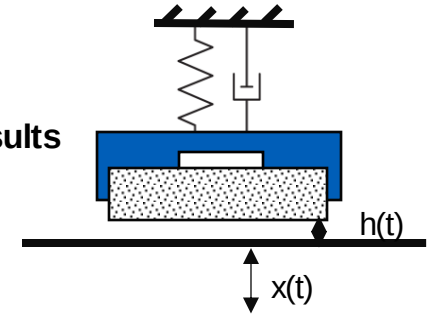
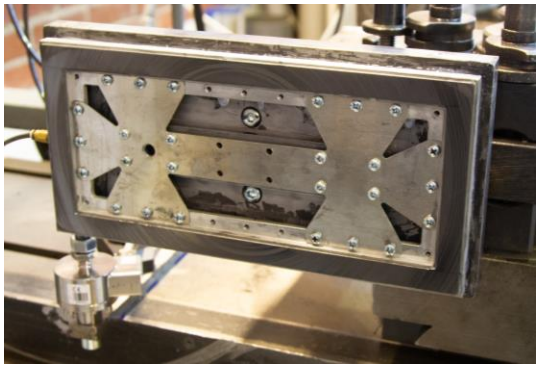
Arotor test rotor ecosystem: force and acceleration measurement at both bearings, 4-point roundness and center movement measurement, adjustable foundation stiffness and external loading systems,

7. Dynamics of aerostatic seals

Investigate behaviour of aerostatic bearing in dynamic conditions, ie., with runout of the mating surface.

- **Simulation and experimental study**
- **Interest in leakage and runout tolerance of the seal**
- **Validate simulation against test results**





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8. Implement gear failure test setup to a scaled down marine propulsion powertrain

- **Design and build changeable gear failure test setup**
- **Investigate different gear failures and study how to implement them in the test setup**

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9. Development of an IoT battery powered torque sensor

Investigate different torque measurement methods and build a wireless prototype for a drive train system

- **Investigate torque measurement methods, which can be used in battery powered applications**
- **Design, build and test**

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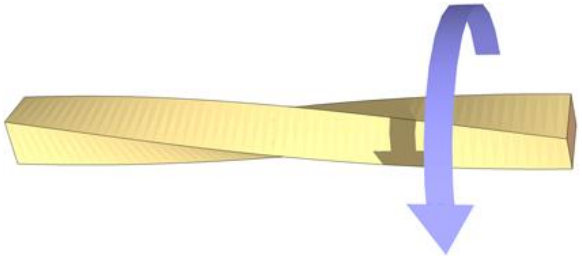

https://en.wikipedia.org/wiki/Torsion_(mechanics)#/media/File:Twisted_bar.png

10. Charging of wireless on-shaft sensor

Design and implement a rotating sensor charging system

- ***Literature review for charging of moving wireless sensors***
- ***Design, implement and test a charging setup for a wireless on-shaft sensor***

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