LARGE
STRUCTURE
PRODUCTION

Model-, Simulation-, and Data-Based Control of Gantry-Based Robotic Operations

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PhD Thesis

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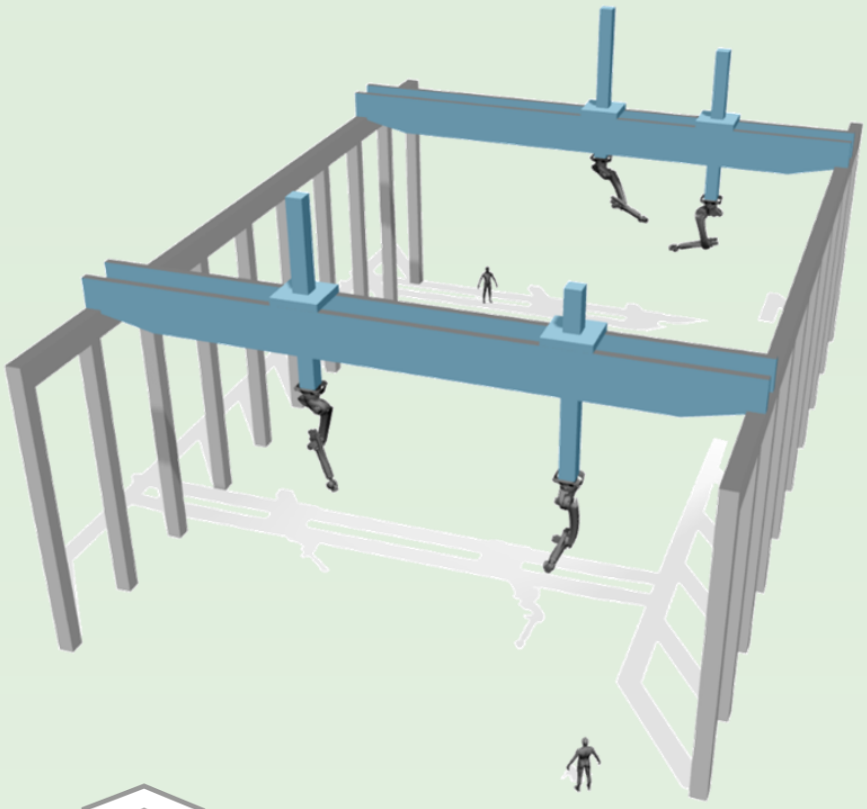
1. Background

The PhD is created on the basis of SDU's new centre for Large Structure Production (LSP). The main ambition of LSP is to create a laboratory at Odense Havn (Port) for development and testing of new solutions in relation to the automation of large structure production, such as ships and buildings. Regarding this specific PhD, the structural dynamics relating to a large gantry-based robotic system is the focus. Here, challenges such as dynamic structural stresses and strains as well as deformations arise which must be countered.

It is of interest to develop methods and models that can simulate and monitor the structural dynamics and changes of the large gantry-based robotic system. The student, Jens Kristian Mikkelsen, has a background in SDU's engineering program Physics & Technology and has experience in structural analysis of wind turbine towers and will use and further develop his knowledge on the field during the project.



2. Objectives

- Structural analysis of the multi-robot gantry system.
- Development of a physics-based and data-driven model of the structural behaviour of the multi-robot system
- Development of optimized control methods based on the simulation model

3. Methodology

- Simple data-driven/physics-based models
  - Simple beam with moving mass
    - Physics-based model of structure
    - Practical setup in laboratory as well
  - Utilise different system identification methods for the moving mass
  - Control strategy to compare performance between physics-based model and measured results
- Structural dynamics of the full gantry system
  - Finite element modelling and analysis in COMSOL
    - Minimise computational complexity since the structure is complex
  - Construct data-driven model as proxy for the COMSOL model
- Utilise data-driven methods based in vibration control on the gantry system
  - Practical setup of scaled-down gantry system in laboratory
  - Setup data acquisitioning system and perform measurements
    - Mode shapes, deformations at different operations etc.
  - Construct data-driven model as proxy for the practical setup in the laboratory – as in the case of the COMSOL model
  - Control strategy to compare performance
- If within period of the project
  - The models and analyses will be supported by data measurements from the high-precision measurement systems equipped on the large physical gantry system. This will aid the parametric identification of the structure.