

Master of Science

Wire gear for Small Rotary Actuator intended for Low Earth Orbit applications.

—

VEBJØRN ORRE AARUD

Master thesis in Engineering Design ... Spring 2018

Background

In the 21th century the need for lighter, better and cheaper low Earth orbit solutions is increasing due to the increase of more satellites, rockets and systems are being launched every day, i.e Space X. Kongsberg Space Systems is one of the largest divisions of space solutions in Norway, delivering to ESA and more. In fact Kongsberg Space Systems is Norway's largest supplier of space equipment's to ESA.¹

To meet this increase for space applications Kongsberg Space System (KSS) wish to develop a light, high performance, wire geared actuator for small rotary actuator systems.

Problem description

The work shall include:

1. **KSS document standard** – Kongsberg Space Systems document standard are to be followed.
2. **CONOPS**² – A CONOPS shall be included and it should define an introduction to project, stakeholders, project plan and model, test methods/plan and a risk analysis
3. **Boundary design and development**- an initial design phase shall be including to identify bearing loads, clamping and preload in relation to gear ratio and torque.
4. **Design and development phase**- a design phase shall be included to select the best driveline setup for a WG-SRA.
5. **A real life prototype** – The selected driveline shall be produced and owned by KSS.
6. **A test report** – A test report generated by the test of the actuator shall be included.

¹ Kongsberg Gruppen. (19.01.2016). Space & Surveillance. Available: <http://kongsberg.com/en/kds/products/spacetechnologyandsystems/>.

² Concept of Operations

General information

This master thesis should include:

- ✳ Preliminary work/literature study related to actual topic
 - A state-of-the-art investigation, partly based on reports given by KSS and previous work for KSS
 - An analysis of requirement specifications, definitions, design requirements, given standards or norms, guidelines and practical experience etc. Partly based on reports given by KSS and previous work for KSS
 - Description concerning limitations and size of the task/project
 - Estimated time schedule for the project/ thesis
- ✳ Selection & investigation of actual materials are based on reports given by KSS and previous work for KSS.
- ✳ Development (creating a model or model concept) is based on reports given by KSS and previous work for KSS.
- ✳ Suggestion for future work/development

Limitations of the task/project

Preliminary work/literature study

After the task description has been distributed to the candidate a preliminary study should be completed within 4 weeks. It should include bullet points 2 and 3 in “The work shall include”, and a plan of the progress. The preliminary study may be submitted as a separate report or “natural” incorporated in the main thesis report. A plan of progress and a deviation report (gap report) can be added as an appendix to the thesis.

Bullet points 2 and 3 is seen as a pre-study and the major fields of this thesis builds around bullet points 4 to 6.

In any case the preliminary study report/part must be accepted by the supervisor before the student can continue with the rest of the master thesis. In the evaluation of this thesis emphasis will be placed on the thorough documentation of the work performed.

Reporting requirements

The thesis should be submitted as a research report and should include the following parts; Abstract, Introduction, Analysis (analytical and numerical) & Materials & Methods & Calculations, Results & Discussion, Conclusions, Acknowledgements, Bibliography, References and Appendices. Choices should be well documented with evidence, references, or logical arguments.

The candidate should in this thesis strive to make the report survey-able, testable, accessible, well written, and documented.

Materials which are developed or/and funded by Kongsberg Space Systems during the project (thesis) such as software/codes or physical equipment are considered to be properties of Kongsberg Space Systems. i.e prototypes. The thesis its self as a paper is owned by the student, Vebjørn Orre Aarud. The thesis its self may also be used by UIT for research and lectures purposes upon request approved by KSS and Vebjørn Orre Aarud.

Documentation for correct use of such information should be added, as far as possible, to this paper (thesis). See separate contact.

The text for this task should be added as an appendix to the report (thesis).

The report (Abstract, Introduction, Analysis (analytical and numerical) & Materials & Methods & Calculations, Results & Discussion, Conclusions, Acknowledgements, Bibliography, References) should not interfere with KSS standard. Any additional material should be included in the appendix.

General project requirements

If the tasks or the problems are performed in close cooperation with an external company, the candidate should follow the guidelines or other directives given by the management of the company.

The candidate does not have the authority to enter or access external companies' information system, production equipment or likewise. If such should be necessary for solving the task in a satisfactory way a detailed permission should be given by the management in the company before any action are made.

Any travel cost, printing and phone cost must be covered by the candidate themselves, if and only if, this is not covered by an agreement between the candidate and the management in the enterprises.

If the candidate enters some unexpected problems or challenges during the work with the tasks and these will cause changes to the work plan, it should be addressed to the supervisor at the UiT Campus Narvik or the person which is responsible, without any delay in time.

Submission requirements

This thesis should result in a final report with an electronic copy (i.e. CD/DVD, memory stick) of the report included appendices and necessary software codes, simulations and calculations. The final report with its appendices will be the basis for the evaluation and grading of the thesis. The report with all materials should be delivered by using Wiseflow. If there is an external company that needs a copy of the thesis, the candidate must arrange this. A standard front page, which can be found on the UiT Campus Narvik internet site, should be used. Otherwise, refer to the "General guidelines for thesis" and the subject description for master thesis.

The final report with its appendices should be submitted no later than the decided final date. The final report should be delivered to the adviser at the office of the Department of Computer Science and Computational Engineering.

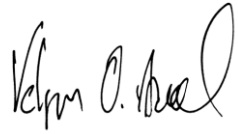
Date of distributing the task: 1.01.2017

Date for submission (deadline): 11.06.2017

Contact information

Candidate

Vebjørn Orre Aarud, vebjrn_aarud@live.no, 93286539

A handwritten signature in black ink, appearing to read 'Vebjørn Orre Aarud'. The signature is fluid and cursive, with the first name 'Vebjørn' being the most prominent part.

Supervisor at Kongsberg

Karl Patrik Mandelin, karl.patrik.mandelin@kongsberg.com, 41477668

Supervisor at the Universitetet i Tromsø – Norges arktiske universitet

Klas Pettersson, klas.pettersson@uit.no, +4776966280