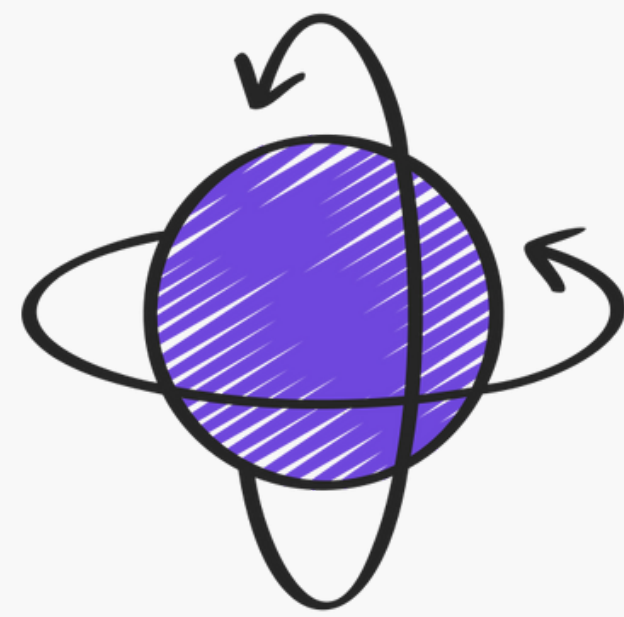# Optical sensor for high-precision measurement of axial rotation (roll)

1.

OBJECTIVE

To design, develop, and validate an optical sensor capable of high-precision measurement of axial rotation or roll.

BACKGROUND

- Advancements in rotation sensors: From huge laser interferometers to compact and affordable offering diverse application and precision.

INTRODUCTION

There are a number of ways you could measure axial rotation:

- Gyroscopes
- Inclinometers
- Laser interferometers
- Digital holography
- Rotary encoders

Pugh matrix analysis favoured interferometers as a top choice for progression.

2.

3.

METHODOLOGY

- Fibre optic interferometers require couplers, lasers, photodiodes and optic cables
- Torsional pendulum was used to create rotation to be measured.
- Data recorded by the photodiode was recorded for a variety of frequency of oscillations.
- Results were validated and processed in MATLAB

4.

RESULTS

- Tested Interferometer's roll measurement using MATLAB's signal processing.
- Analysed the data statistically, assessing interferometer's sensitivity and accuracy.
- Noise in signals reduced by MATLAB's 'movmean' function.
- Identified limitation: unable to detect direction of rotation accurately.
- Proposed improvements not feasible within project's time constraints

5.
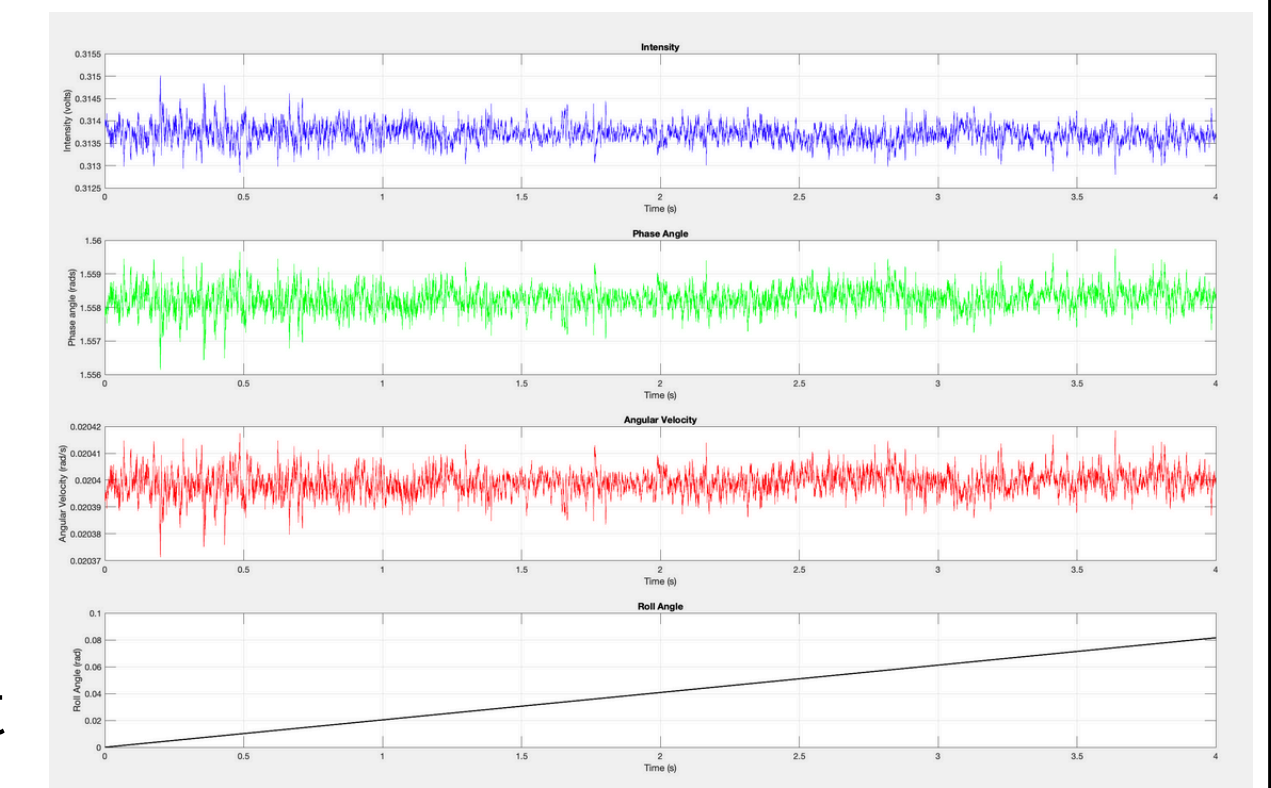
CONCLUSION

- System unable to detect direction, hindering roll angle calculations.
- Proposed solution: introduce quadrature detection for precise roll angle calculations.
- Future work: design and develop a rotating motor to make the interferometer more reliable.
- Limitations: non-autonomous roll angle detection, inability to detect direction.
- Project outcome: functional interferometer determining axial rotation with room for improvement.

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