Finite Element Analysis of a MMR with different power train configurations

Conor O'Brien

Aim of the Project

The aim of this project is to research, design and test using finite element analysis the impact of locating the gearbox Infront of a mechanical motion rectifier in a wave power generating system.

Background

This project is based on the use of an assembly used to harness the enormous energy of waves and convert it into useful electricity. The mechanical power of waves and turning it into electrical energy for consumption is done using a PTO technology called Aontreo. Turning wave energy, which has high torque low velocity and is bi-directional into low torque high velocity and one direction (rotating shaft) used to turn a generator to create electricity.

This is possible by using a Mechanical Motion Rectifier (MMR), which converts the bi-directional motion of waves into one direction and a planetary gearbox to increase velocity and lower the torque. This project intends to investigate using Finite Element Analysis using a SolidWorks model the reversing the order of two operating the components in an existing assembly, namely the planetary gearbox and mechanical motion rectifier.

Assembly

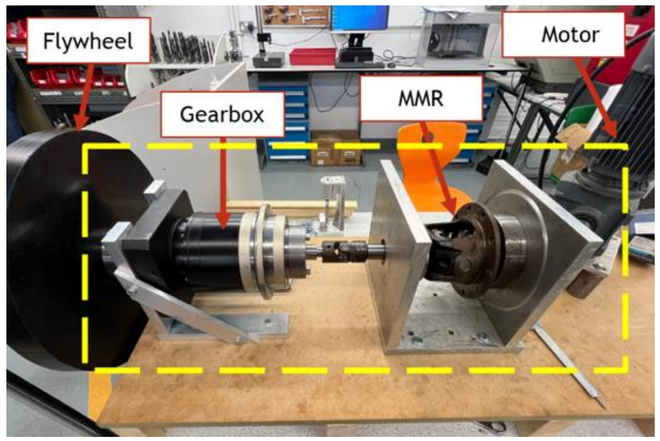

Figure 1: Full Assembly

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The full assembly includes:

1. Motor
2. Mechanical Motion Rectifier (MMR)
3. Gearbox
4. Flywheel

In the full assembly, the motor is being used to simulate wave like conditions. A sine wave will be used to simulate the waves being bi-directional and a low RPM output from the motor would give a high torque.
The MMR is used to convert bidirectional motion into one direction only
The Planetary gearbox is used to increase velocity and lower torque for the purpose of electrical generation.

Finite Element Analysis

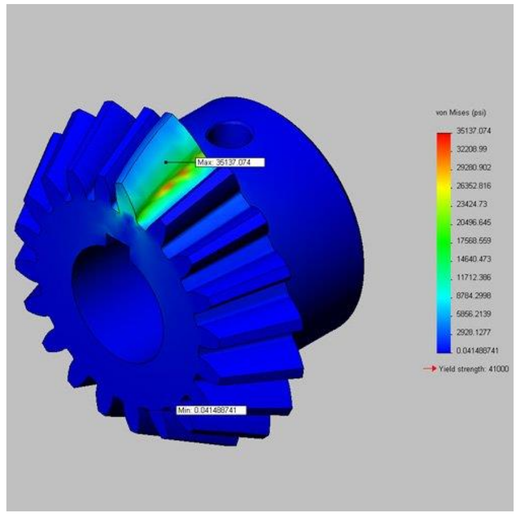

Figure 2: FEA used on a Bevel Gear (Example)

Finite element analysis is a method of using computer software to predict how a material will behave under certain simulated load conditions. It uses a numerical technique to split an object into man pieces, equations are then created which engineers use to perform finite element analysis.

<u>Advantages of FEA</u>

•Increased Accuracy of analysing stress that might affect a product.

•Improved design as developers can assess and change the design on how the product is affected by stress.

•Increased productivity as more high-quality products can be developed in a shorter time using FEA software.

Conclusion

The research and testing carried out found that while there may be an operation advantage to such a configuration, such as the MMR becoming more compact, there be extra maintenance required and special practices to ensure smooth operation of the assembly. One of the main problems associated with this configuration is the uneven wearing of gear teeth. Unlike the MMR, the gearbox gears do not continuously rotate in one direction in this configuration, but instead rotate back and forth 10 – 20 degrees. This causes some of teeth on the gears to never get used and therefore in order to solve this problem mitigation must be put in place in order to get longevity in this type of configuration.

References

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