The Design and Model of a Power Take Off (PTO) as one Unit Nacelle to be used on an Attenuator Wave Energy Converter - Kevin McCourt

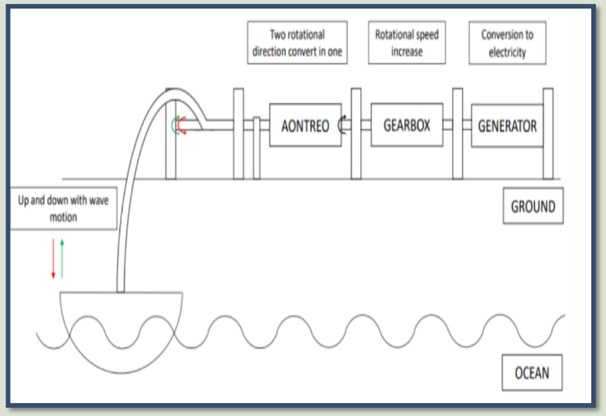
Aim of the Project

The Aim of the project was to design and model a power take off system (PTO) housed within a nacelle that could be used on an attenuator wave energy converter (WEC)

Objectives

- To carry out research on an Attenuator Wave Energy Converter
- To design a Power Take Off system housed within a nacelle
- To create a model of this design in SolidWorks

Background

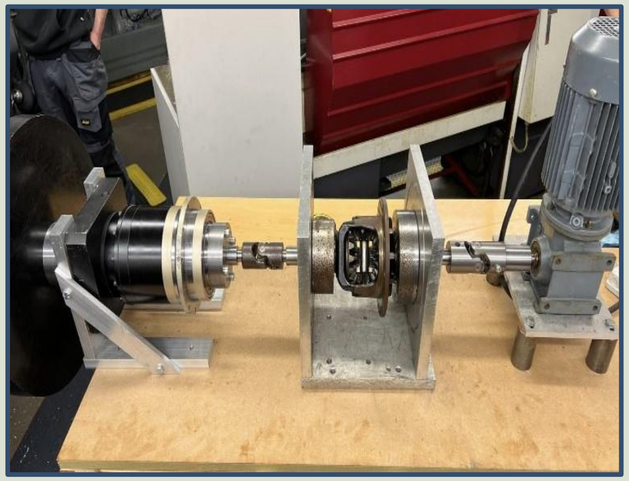


Schematic of Wave Energy Converter

The purpose of a wave energy converter is to take the power of the ocean waves and convert this into electrical energy. This is achieved with the use of a power take off which is essentially a shaft that can transmit this power. The up and down movement of the waves creates a bi-directional motion on the input shaft of the PTO, this bi-directional motion is then converted to one directional motion with the use of a mechanical motion rectifier (MMR). A gearbox will then increase the speed of the shaft so that it can drive a generator at an adequate speed to produce electrical power. Basically, the wave energy converter takes a high torque, low velocity, bi-directional input and converts this to a low torque, high velocity, one directional output

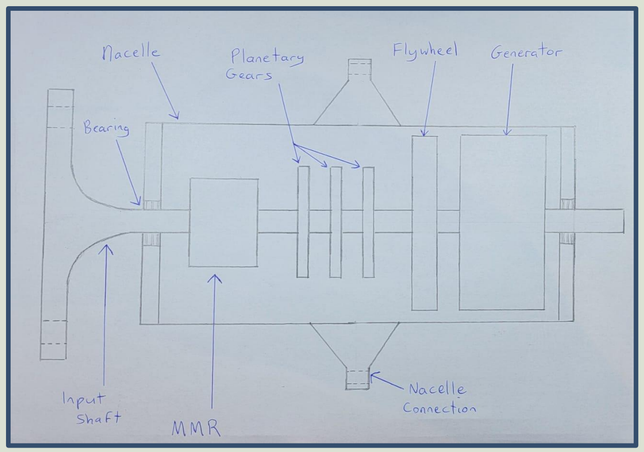
Design

The design of the model was to be based off an assembly that was produced in a previous project. This assembly can be seen in the image below. On the far right a motor is used to simulate sea wave conditions by creating a bi-directional input. That shaft then goes to the MMR, then to the gearbox and then out to a flywheel. The design was created with this assembly in mind. The components were to be similar and remain in the same orientation within the rig



WEC assembly from a previous project

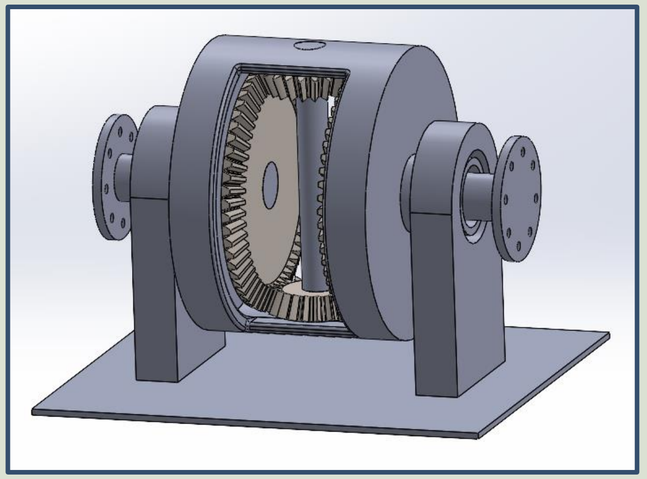
Seen below is the design sketch. It contains all the same components as the previous project with the addition of a nacelle which houses all the components and a generator which is where the electrical power is produced from. The nacelle housing is what allowed this assembly to be used on an attenuator WEC



Design Sketch

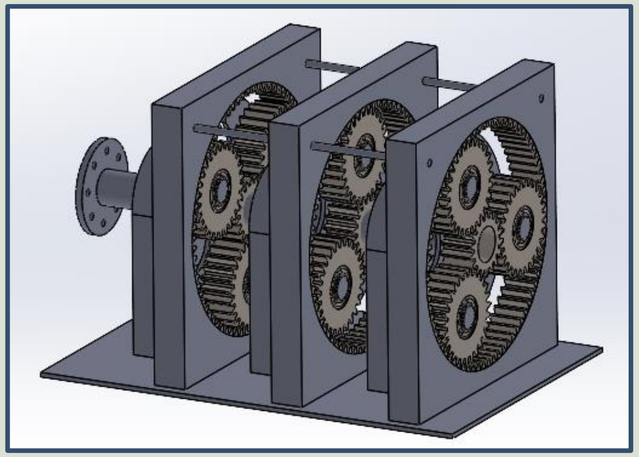
Modelling

SolidWorks was used to create all the parts and assemblies throughout the modelling process. The MMR and gearbox were the most intricate parts to model out of the assembly



Mechanical Motion Rectifier (MMR)

The gears in the MMR were created using the toolbox function in SolidWorks. By inputting the desired module and number of teeth, the correct bevel and pinion gears were created and mated successfully



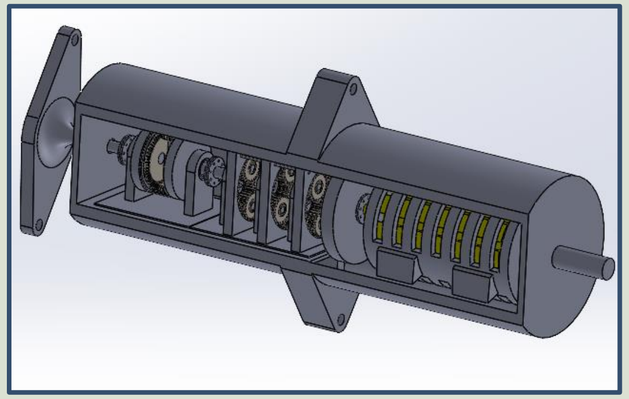
Planetary Gearbox

The gears in the gearbox were also created using the toolbox function. Each of these planetary gears had a speed ratio of 1:5. As there are 3 gears, a speed increasing ratio of 1:15 was achieved

Modelling

The image below shows the fully completed assembly of the power take off as one unit nacelle. The nacelle was a sealed unit however there is a partial cutaway on this model for the purpose of showing the inner components

Housed within the nacelle was the MMR, planetary gearbox, flywheel and generator. A flange which was mounted on the end of each shaft allowed the shafts to be bolted securely to one another



Model of Full Assembly

Conclusion

- After carrying out research on an attenuator wave energy converter, a design was sketched and then modelled using SolidWorks
- Basing the design off a previous project was a huge help in facilitating the design process as there was a clear reference of what needed to be created before sketching the design
- With the aid of formulas, the gear ratio's, module and number of teeth were obtained. This was critical in ensuring each planetary gear had a ratio of 1:5

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