Make It Real CAD Engineering Challenge Report

By Manu Lange

1 Introduction

Since the beginning of 2013 I have been working on an industrial all-terrain vehicle for inspecting remote assets. This is a conjoint effort between Massey University and Transpower Ltd. NZ. We developed a prototype vehicle to prove that the concept was viable. This vehicle however was based on an existing chassis and did not fit the bill. So I designed a new modular chassis that was capable of being easily adjusted to suit the payload required. At its core lies the "Main_Module" component (hereafter referred to as 'module') seen in Figure 1.

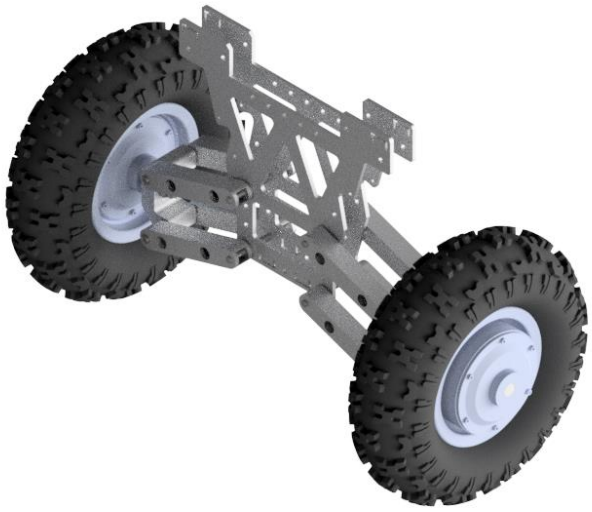

Figure 1: Main Module of the revised ATV

This modules main functionality was its flexibility. It has already gone through three revisions, and yet parts from the first revision can be reused. The width, height and module mount slot have all changed over the year to meet demands. This flexibility was something the old robot (Figure 2) did not offer and has been invaluable to delivering a targeted solution.

Figure 2: Original Proof on concept ATV

2 Explanation of purpose

The part can be easy used to make robots of variable width, hight, and wheel count. Since the wheels are hub motors, the vehicle maintains excellent all-terrain capability. A six wheeled configuration (the one I manufactured) is pictured in Figure 3.

Figure 3: 6 Wheeled ATV example

This chassis then is covered with a cover that allows for modules to be inserted into the gaps that contain the battery packs, controllers and communication. The slots in the top of the model allow for

units (such as in our example) an arm to be inserted. However, the entire design is based around modularity. This robot will be used to remotely inspect (via cameras and the internet) assets that are of remote or hard to access nature. Transpower has estimated that technician call out costs in the order of 100's of thousands could be saved by having these units placed in each substation, ready to be a first responder. But since Transpower did not want to own any of the design, we designed it from the ground up based around modularity so that the application can easily be adapted to other client's needs.

3 Explanation of Creation

All the parts seen (except for the hub motor, which was supplied) were created in Autodesk inventor Professional 2016 (Student Edition). The individual parts were made in logical order, starting with the main frame plate. This was created in a manner that the features were split into logical steps that can easily be reviewed and changed as demonstrated in Figure 4.

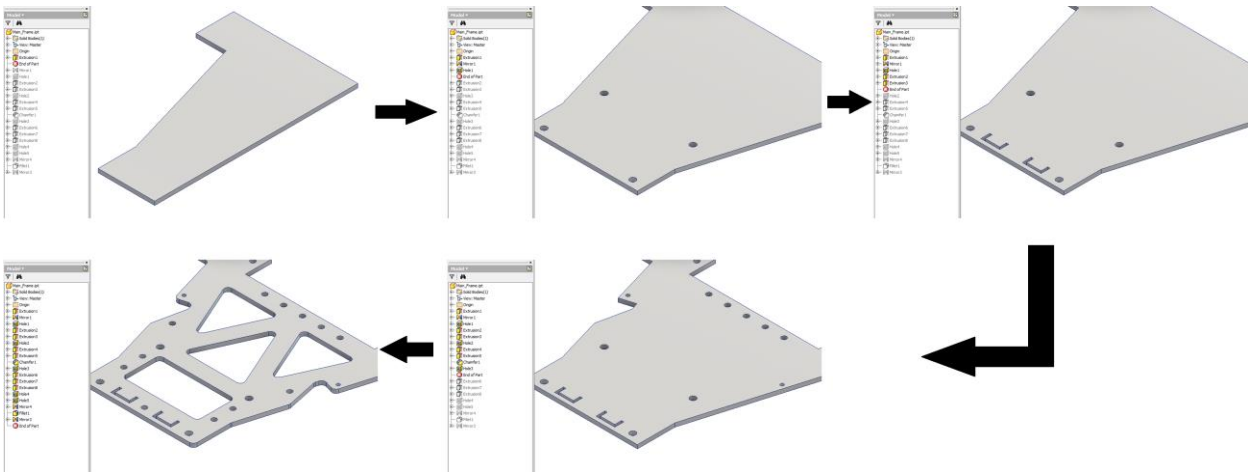

Figure 4: Main Frame Feature build up

This was done for the main link arms and the wheel mount. These were then placed into an assembly and the Content Center was used to insert standard components such as locknuts, setscrews, retaining rings and more. From the Power transmission section shafts were designed to link the 4bar system together. The assemblies were also made flexible so that the movement of the link bars could be visualized.

4 Conclusion

Since working with Inventor I have learnt a lot about the differences from other CAD products. An example being the vast amount of engineering components and features available from the content server. These make inventor very easy to use and ensure that designs will be using standard, off the shelf components and design standards. Since the career ahead of me involves (hopefully) a lot of robotic design for solutions 3D CAD will play a major role. It is also critical to be able to use a range of software to design and present solutions generated. From the above design the ATV was built and assembled with various fabrication techniques including laser cutting and CNC milling. The resulting

chassis and the robot in action can be seen below at various stages in its design. This is an ongoing project and still has plenty of design left.