5 Axis CNC Upgrade

Leon Devitt Michael Lynch Ronan Reynolds Vincent Bleach

LIT LIMERICK INSTITUTE OF TECHNOLOGY

Aim of the Project

The Aim of the project is to upgrade the current 4 Axis CNC Machine into a 5 axis capable machine. This involves designing and building a complete working assembly. The currant machines forth axis rotates around the A axis. Our goal it to enable the new assembly to rotate around the A and C axis's using a trunnion table as well as two stepper motors to control the necessary movements.

Objectives

- ⊡ Review the existing machine and document the setup.
- ⊡ Evaluate the requirements to add a further 2 axis table.
- ⊡ Design a fit for purpose assembly of the elements needed to insure a working machine.
- ⊡ Manufacture all components effectively and safely using various machining methods.
- ⊡ Assembly and test the new 5 Axis capable CNC

Background

Software and technological advancements in modern times has made it possible for 5-axis machinery to become cheaper and more user-friendly. There isn't a multi-axis machine being manufactured today that isn't computer numerically controlled. The breakthrough of CNC controlled machines revolutionised mass productions of parts in industry. The history of multi-axis machining however dates to the 1940's before the implementation of CNC machine.

Multi-axis machines were used before CNC was even created. These machines were operated on cam plates with levers and were used to control the motions of the tool, table and rotary movements, as well as to clamp the fixtures. These manual multi-axis machines, although massive and bulky, were well-suited to mass production. They were the precursors of the 5-axis devices that are used today. (Astro Machine Works, 2019)

Design

The design started with the inspection of the existing Machine and evaluating the space available to integrate the two new axes. The existing table had plenty of space in the X and Y directions, the Z axis space was very limited. This made the design very difficult as it needed to be as low as possible but still be able to rotate around the A axis by 180 degrees. To get around this one of the motors was placed onto the trunnion table.

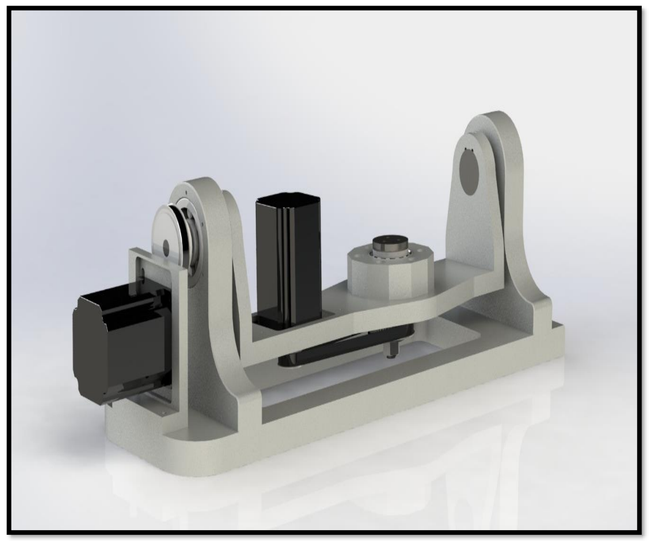

Figure 1. Design render

Manufacture

Machining

A total of 11 components needed to be machined to complete this project. The machines used where the Spinner 5-axis CNC mill and the Cincinnati Mazatrol lathe. All the shafts were made on the lathe while all other components were made on the mill. The components to be machined were all programmed by the group on Solidcam and Cimco.

Figure 2. Trunnion plate

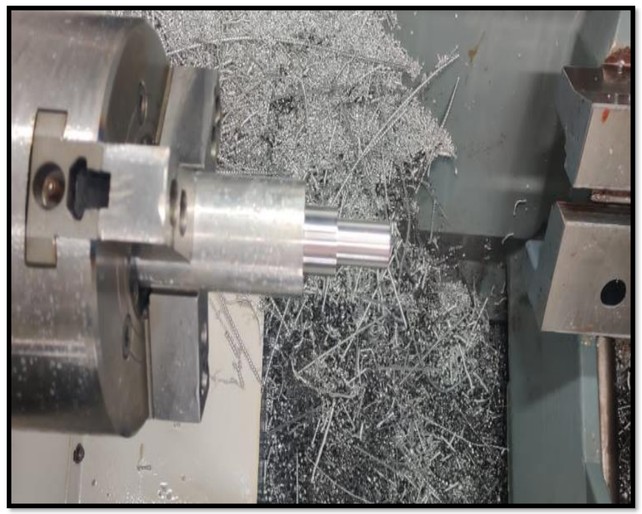

Figure 3. A axis Shaft

Conclusion

Through a great team effort this project evolved from an idea on paper to a full design through solidworks and on to manufacturing. With extensive research and brainstorming a simple but effective design was produced while making sure no part of the assembly is under any extreme forces. Unfortunately due to extenuating circumstances all components needed to produce the final assembly were not machined. The team is still very proud out what it achieved during the duration of this project.

References

Astro Machine Works, 2019. *What Is 5-Axis Machining?.* [Online] Available at: https://astromachineworks.com/what-is-5-axis-machining/#History-of-5-Axis-Machining

Acknowledgements

We would like to thank and acknowledge our Supervisor, Ciaran O Loughlin. Without whom this project would not have materialised, his support, guidance and advice went a long way in overcoming problems. As well as the time he spent machining

We would also like to thank and Acknowledge Dr. John Walsh for his help in machining out our components on the spinner.