**Student Details:**

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**Project Details:**

Project Title: Four Axis Hotwire cutter tool path optimisation: An approach for correcting for Dynamic Kerf Width and wire Bow.

Short Project Description

When using a CNC Hotwire cutter to manufacture aerosurfaces maintaining accurate part geometry becomes challenging, Hotwires cut suitable materials using a heated wire, the position and posture of the wire is controlled by a set of computer controlled axis’ and a microcontroller (Figliolini, 2018).

Cutting is accomplished by pyrolyzing the parent material in a region around the wire, this can either occur by direct contact with the wire, or by the thermal radiation emitted by the wire. Which cutting ‘mode’ depends on machine feed rate, the heat flux and the material behaviour, in each mode the width of the kurf(Cut Width), will change(Karmakar, 2018). Additionally the part geometry can affect the kurf size.

All these factors result in a highly dynamic kurf size, if not accounted for this will result inaccurate part geometries, this is particularly evident when manufacturing aerofoils. Aerofoils are both highly curved and have thin geometries which makes accurate manufacturing more challenging, from experience the error in chord length can be as much as 20% which significantly effects aerodynamic performance.

This project builds on previous work done by myself, for the UAV society, and will combine and implement work done by other researchers in developing a method and tool that can improve the part geometry.

Figliolini, G., Rea, P. and Cocomello, C., 2018. Mechatronic design and prototype of a 4-DOFs hot-wire CNC cutting machine. In *Advances in Service and Industrial Robotics: Proceedings of the 26th International Conference on Robotics in Alpe-Adria-Danube Region, RAAD 2017* (pp. 591-598). Springer International Publishing.

Karmakar, N. and Subbiah, S., 2018. Investigating Bowing of Hot Wire during cutting of EPS. *Procedia Manufacturing*, *26*, pp.671-680.

Aim:

principle aim of improving the dimensional accuracy of aerofoils produced by a 4 axis hotwire cutting machine.

Objectives:

OB 1. Reexamine the state of the art, how have others approached this problem?

OB 1.1 Collate methods and assess suitability, decide on path for further development, Can heuristic methods provide necessary results or is a more simulation based solution required?

OB 1.2 examine if a simulation based solution is tractable.

OB 2. Asses state of current software and relative accuracy of the manufactured products.

OB 2.1 Measure manufactured part geometries to quantify error and perform simulation to compare the theoretical aerodynamic performance of the designed part to the manufactured part.

OB2. Implement a computer algorithm that can optimise the toolpath using either a heuristic or simulation based approach to decrease error in part geometry.

OB3. Package the algorithm for ease of use by the society and university.

**Supporting Evidence:**

Project builds on prior work from (*select one*):

* Student society project

Summary of prior work and evidence of success (<200 words): *It should be clear how the past project is different to the proposed work, but provides the necessary foundational knowledge/skills. Evidence could* *include: strong grade for submitted work; completion of a report/paper documenting the work; presentation of the work at a meeting/conference; successful demonstration of a prototype; winning an award for the work. It should be clear from the evidence that you are capable of managing an independent research project and have a high likelihood of succeeding in this unit.*

Attached via the link included is a code repository of an initial iteration that is currently in use by the UAV society, in addition to staff and researchers at UOM, the current tool uses a naive approach that does provide margin improvements in some specific cases, it does however not currently correctly generate the for cases such as large wing taper ratios, thin foils, thin wing trailing edges.

https://github.com/RolloTully/Wing-Cutter

In addition to this already existing work and an understanding of the problem topic I have run the UAV society as president and de facto president for 2 years making entries to both the BMFA and IMechE which have helped me develops the necessary time and project management skills to complete the ARP. As president I have also given presentation to the Industrial Advisor Board as well as working as a part time teacher shows sufficient communication to communicate the concepts developed to a lay audience.