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Code To Combustion: CNC Rotor Replication Using CAM

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Abstract

In the current landscape, computer-aided design (CAD) and computer numerical control (CNC) technologies have greatly enhanced manufacturing processes, allowing rapid and high-precision production. This project will focus on recreating a Wankel engine rotor, using SolidWorks for design and Mastercam for Computer-Aided Manufacturing (CAM) simulations. The process begins with SolidWorks, which is used for a template of a high-precision rotor model. Mastercam is then utilized for the CAM programming, allowing for the creation of intricate tool paths and tool usage simulations. This approach is vital for complex objects like the Wankel engine rotor, which demands high precision. The primary objective of this project is to deepen understanding and proficiency in CAM, in this case, for a more complex piece.

Introduction

A Wankel engine is a smaller engine that replaces pistons to perform combustion in exchange for a rotor that performs the same process while requiring fewer moving parts. Wankel engine rotors can be found in snowmobiles, jet skis, chainsaws, AUVs, and cars. The design for this rotor was made possible using a SolidWorks template to achieve accuracy in dimensions for the CAM simulations. For our visual purposes, the rotor would also be recreated with additive manufacturing (3D printing, **Figure 1**) to get a better hands-on visual of the product. With the model available, Mastercam is used to create the simulation and code that can be used for subtractive manufacturing. For the objective of this project, we will establish constraints on specific tool path creations, considering cost, time, and efficiency factors. In the end, we still want to manufacture the rotor with the ideal substitutions to remain as accurate as possible, and the end goal remains the same, which is to get a better understanding of the proficiency of CAM in a manufacturing setting and with a complex part.

Process

- Upload the SolidWorks rotor file into Mastercam to set up the stock (**Fig 1**).
- The stock is set up and dimensioned to match the original model, allowing for less excess material (**Fig 2**).
- From here, I could use different milling tool options to cut the specific shapes of the rotor. The directions and commands can be seen through the different colors in **Fig 3.**
- Lastly, the code (G code, **Fig 4**) is created to upload into a CNC machine, which reads and performs the specific movements to manufacture the part. The final product is shown in **Fig 5**

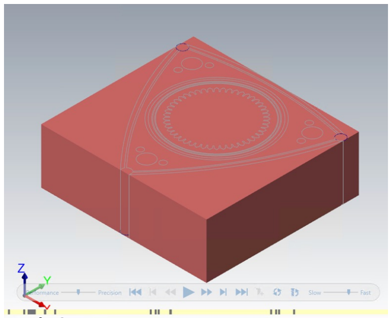

Fig 2.

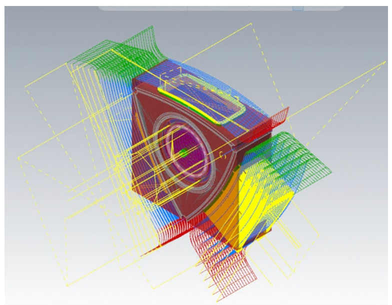

Fig 3.

```
%
O0000(WANKEL ROTOR LUIS LUNA)
(DATE=DD-MM-YY - 28-11-23 TIME=HH:MM - 16:46)
(MCAM FILE - C:\USERS\LUIS.LUNA\DOWNLOADS\RO
(NC FILE - C:\USERS\ADVANTAGE\DOCUMENTS\MY M
(MATERIAL - ALUMINUM INCH - 2024)
( T1 | 1/2 FLAT ENDMILL | H1 )
( T2 | 1/4 FLAT ENDMILL | H2 )
( T3 | 3 CENTER DRILL | H3 )
( T4 | 1/32 FLAT ENDMILL | H4 )
( T5 | 1/16 FLAT ENDMILL | H5 )
N100 G20
N110 G0 G17 G40 G49 G80 G90
N120 T1 M6
N130 G0 G90 G54 X4.8447 Y.9546 A0. S1069 M3
N140 G43 H1 Z2.
N150 Z.2
N160 G1 Z-.0967 F6.42
N170 X4.3633 Y1.0895
N180 G3 X4.2284 Y1.108 I-.1349 J-.4815
N190 X3.7469 Y.743 I0. J-.5
N200 G1 X3.6763 Y.491
N210 X3.5889 Y.2154
N220 X3.4918 Y-.0586
N230 X3.385 Y-.3308
N240 X3.2685 Y-.6014
N250 X3.1422 Y-.8704
N260 X3.006 Y-1.1377
N270 X2.86 Y-1.4034
N280 X2.704 Y-1.6675
N290 X2.5379 Y-1.9301
N300 X2.3616 Y-2.1913
N310 X2.175 Y-2.4511
N320 X1.978 Y-2.7095
N330 X1.7703 Y-2.9666
N340 X1.5518 Y-3.2225
N350 X1.3262 Y-3.4729
N360 X1.2302 Y-3.5757
N370 G3 X1.0955 Y-3.9171 I.3653 J-.3414
N380 X1.2542 Y-4.2824 I.5 J0.
N390 G1 X1.6195 Y-4.6238
N400 Z.2
N410 G0 Z.25
N420 X4.604 Y1.022
N430 Z.2
N440 G1 Z-.0967 F6.42
N450 X4.1226 Y1.157
N460 G3 X3.9876 Y1.1756 I-.135 J-.4815
N470 G1 X3.9444 Y1.1737
```

Fig 4.

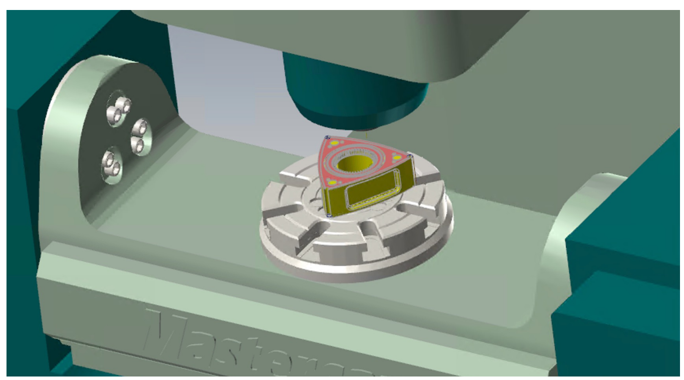

Fig 5.

SolidWorks model

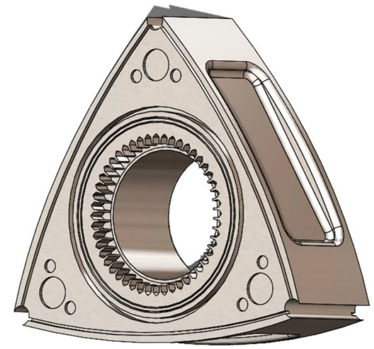

Fig 1.

Conclusion

In conclusion, the successful replication of a rotor using the SolidWorks model and Mastercam for simulation highlights the effectiveness of CNC technologies in the manufacturing process. Mastercam offers various tools for precise cuts while providing straightforward simulations, ensuring accuracy and offering time and cost-saving advantages. Its capability to detect and rectify potential issues before machining will prevent material wastage.

This project showed how the rotor's intricate design would have needed the creation of numerous specific tools; it led me to consider an alternative approach. Additive manufacturing, specifically metal 3D printing, emerges as a better solution. Since this method would save time and money when creating new tools, it also doesn't require a stock to subtract material from and can be more effective in producing complex shapes while reducing waste. These observations contribute to exploring cost-efficient and efficient methods in the manufacturing landscape. Hopefully, we can explore additive manufacturing in a future project and compare the findings.

References

- https://grabcad.com/library/mazda-rx-7-13b-wankel-engine-rotor-1
- Lendel, Mariana. "Mastercam 2022 Mill Essentials Training Tutorial." eMastercam.Com, 12 June 2021.

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