Wankel Rotary Engine

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Abstract

A Wankel engine utilizes an eccentrically turning rotor in a rotor housing to create volume changes for the engine's power cycles. For a thermal power cycle, the combustion chamber's volume changes produce the required intake, compression, combustion, and exhaust. The goal of our project was to design and fabricate an operational Wankel rotary engine by improving upon the progress of last year's engine model. Using Mazda's equations to form the rotor housing of a Wankel engine and past project examples, our team planned to improve the engine model's design and functionality.

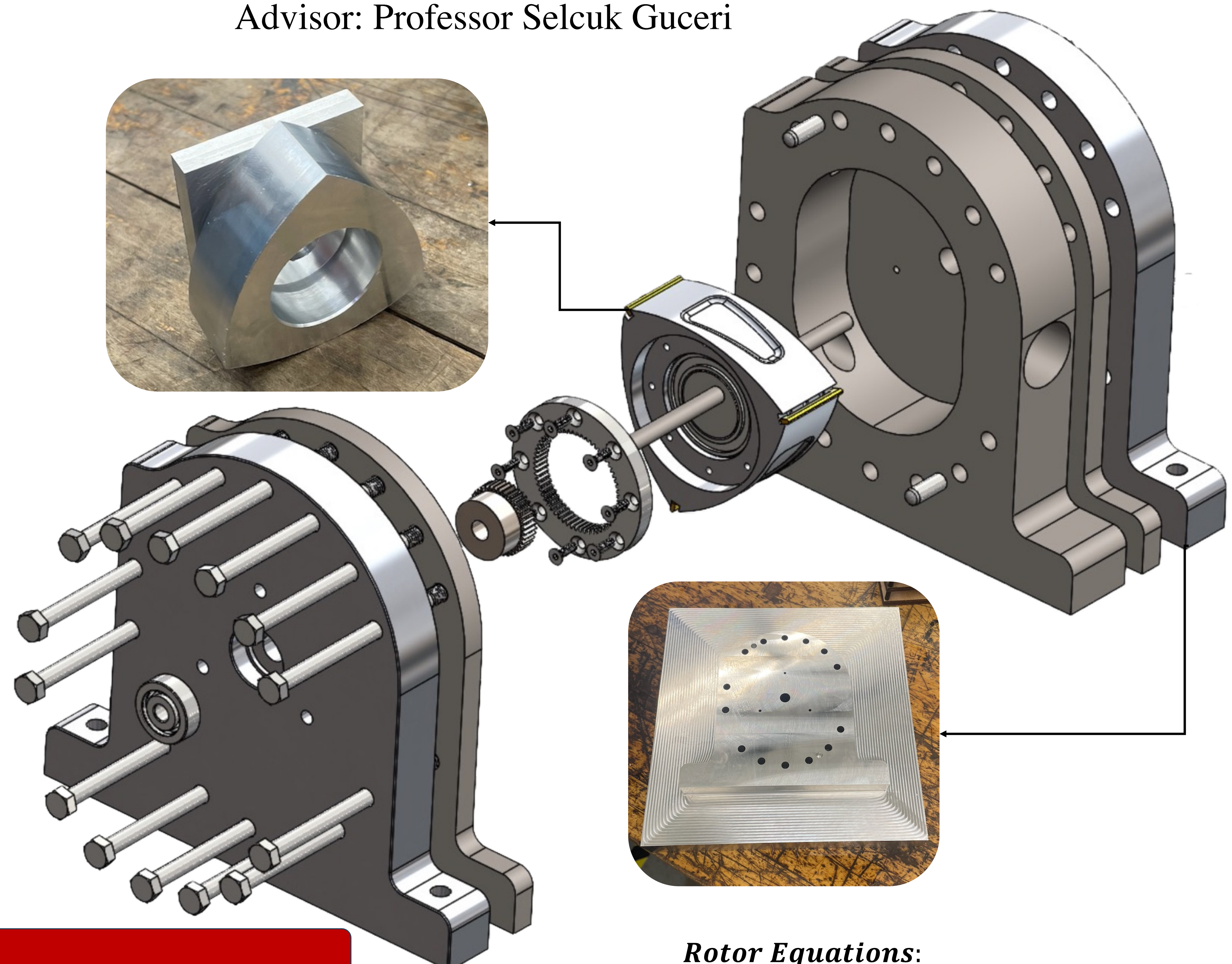
Objectives

•Establish rotor and rotor housing geometry using equations provided by Professor Selcuk Guceri.

•Design all individual engine components using SolidWorks to model a complete working Wankel engine assembly.

•Manufacture rotor, rotor housing, eccentric output shaft, etc., using available CNC machining equipment at WPI.

•As time permitted, develop simple starting mechanism to test and run final engine model.



Outcome

We were able to begin manufacturing some, if not all, of these parts by the end of the term due to unexpected delays. In place of a physical demonstration, the SolidWorks animation – found in the QR code - exhibits the engine's theoretical functionality and provides a solid foundation for future MQP groups to continue finalizing our Wankel engine.

Future Work

We recommend future MQP teams use our SolidWorks model to continue manufacturing all the engine components for final assembly and testing. Teams should design an ignition system using a CDI magnet sensor that will detect each time the rotor compresses against the engine's sparkplugs. This will allow the sparkplugs to ignite every time the rotor passes so the engine can run consistently. The engine would also benefit from a cooling system since the engine is prone to overheating. Researching and acquiring the optimal fuel delivery system and fuel type may also contribute to an operational Wankel rotary engine. For structural integrity and decreasing overall weight teams can research the potential of a two-layer material housing using steel and aluminum.

Rotor Equations:

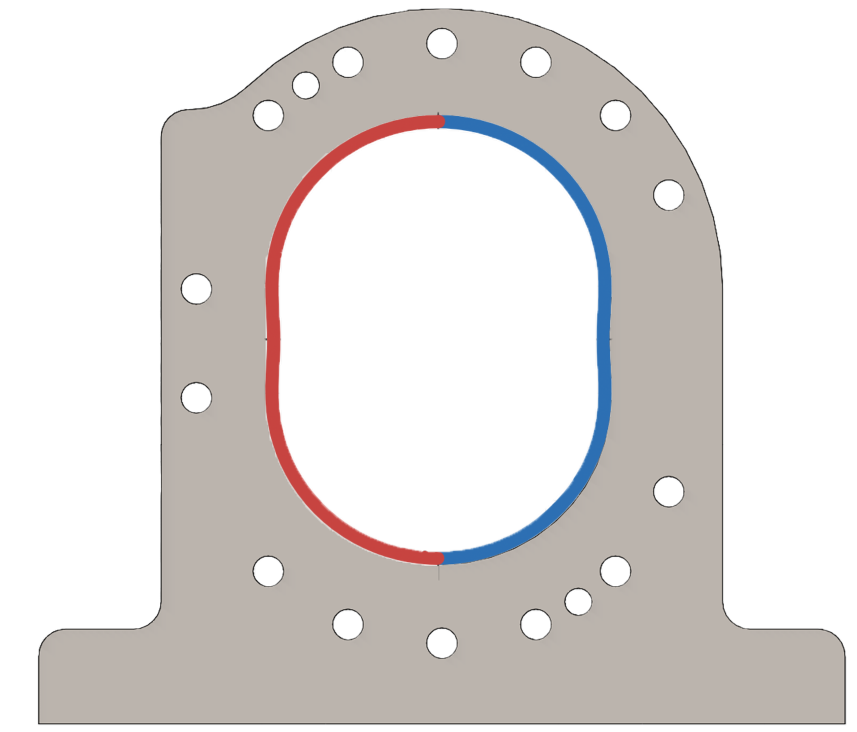
X

$$= R * \cos(2v) + \frac{3e^2}{2R}(\cos(8v) - \cos(4v)) \pm e\left(1 - \frac{9e^2}{R^2} * \sin^2(3v)\right)^{\frac{1}{2}} * (\cos(5v) + \cos(v))$$

Y

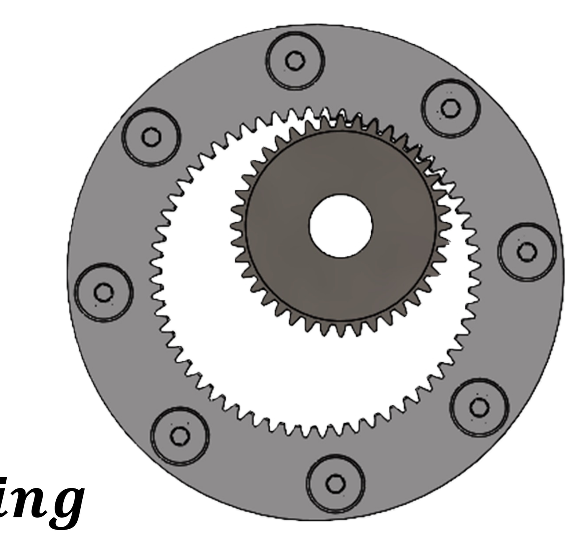
$$= R * \sin(2v) + \frac{3e^2}{2R}(\sin(8v) - \sin(4v)) \pm e\left(1 - \frac{9e^2}{R^2} * \sin^2(3v)\right)^{\frac{1}{2}} * (\sin(5v) - \sin(v))$$

$$v = \frac{1}{6}\pi \sim \frac{1}{2}\pi, \frac{5}{6}\pi \sim \frac{7}{6}\pi, \frac{3}{2}\pi \sim \frac{11}{6}\pi$$



$\boldsymbol{p}$ = *Fixed Spur Gear Radius*
$\boldsymbol{q}$ = *Internal Gear Radius*
$\boldsymbol{e} = eccentricity = \frac{p}{2} = \frac{q}{3}$
$\boldsymbol{K}$ = *Trochoid Constant*
$\boldsymbol{R}$ = *Generating Radius* $= K * e$
$\boldsymbol{A}$ = *apex clearence*

$p = 10mm$
$q = 15mm$
$e = 5mm$
$K = 7$
$R = 35mm$
$A = 0.6mm$



Rotor Housing Equations:

$$X_t = e * \cos(t) + (R + A) * \cos\left(\frac{t}{3}\right)$$

$$Y_t = e * \sin(t) + (R + A) * \sin\left(\frac{t}{3}\right)$$

Rotor Housing Parameters:

$0 \le t \le 3\pi$
$3\pi \le t \le 18.849$