Designing and Prototyping Various Applications of Reuleaux Polygons

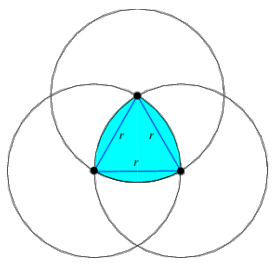
Cluster Innovation Centre
University of Delhi

Abstract

In this paper, we have performed various calculations and derivations regarding the reuleaux polygons, mainly the reuleaux triangle and their applications which includes creating a new omni directional, making gears out of reuleaux triangle and constructing a new type of engine other than the traditional Reciprocating and Rotary engine called a wankel engine, a type of internal combustion engine using an eccentric rotary design to convert pressure into rotating motion.

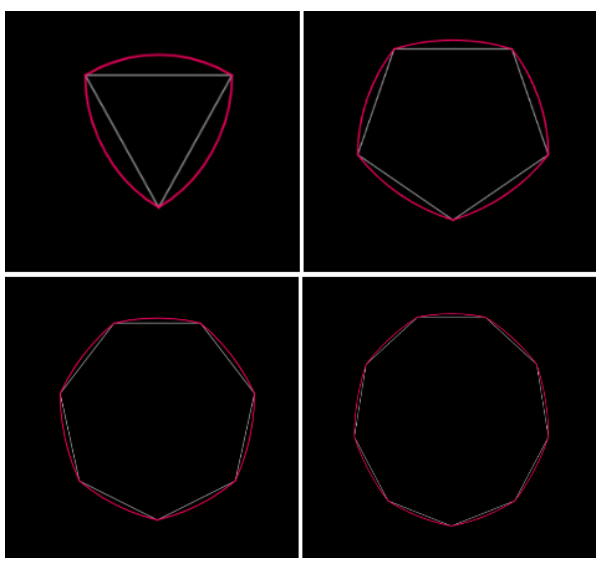
Reuleaux Triangle

The Reuleaux triangle is a figure of constant width; it is obtained by intersecting three (equal) circles with the centers in the vertices of an equilateral triangle and the radius equal to the side of the triangle. The border of this figure is also called Reuleaux curve



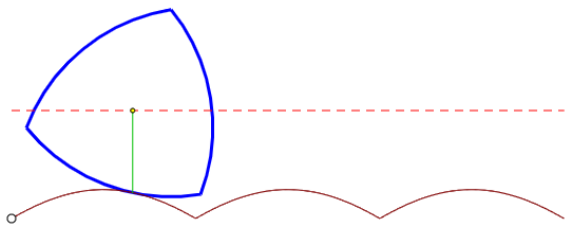
Reuleaux Polygons

When the isodiametric problems for polygons were being studied, reuleaux polygons were used for lots of proof. A Reuleaux polygon is defined as a set of constant width whose boundary consists of a finite number of circular arcs of the same radius. A Reuleaux polygon is not a polygon in the traditional sense, since its edges are not line segments. The following are examples of Reuleaux polygons made around regular polygons. All the shapes are made in javascript using processing environment.

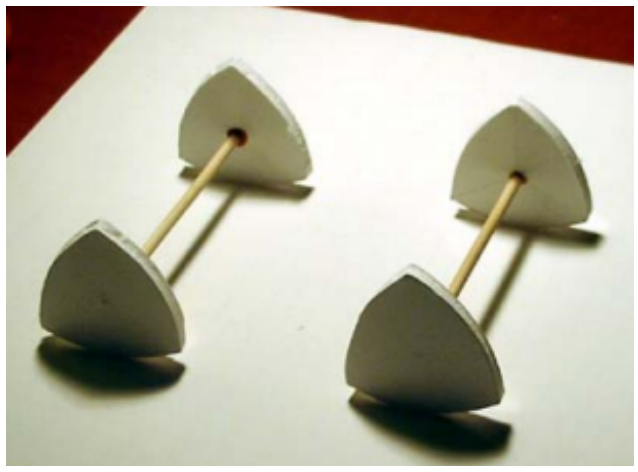


Reuleaux Wheel

Reuleaux Wheel is a unique application of the reuleaux triangle. When rolling a reuleaux Wheel, its height is constant, but the height of its centroid changes.If it had mass, the centroid would be the center of mass. The shape of the centroid locus is not circular, but it is not a single ellipse either. It is composed of parts from four ellipses. When we look closely it resembles a bumpy road.

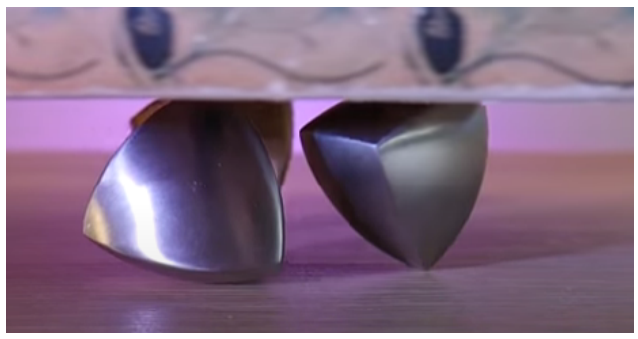


MDF Prototype of a Reuleaux Wheel



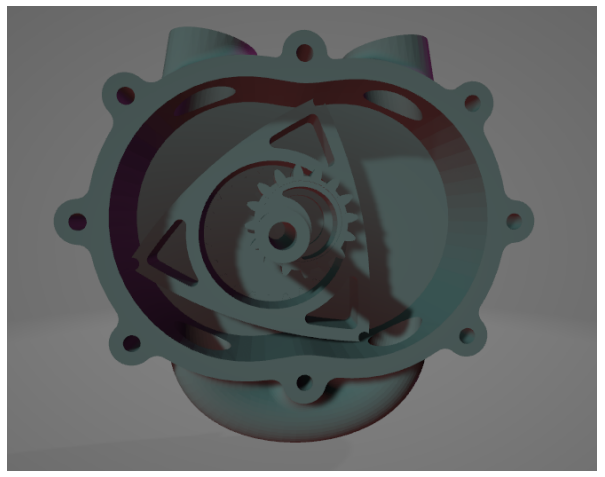
Reuleaux Tetrahedron

Analogous to Reuleaux Triangle, The reuleaux tetrahedron is made by using four overlapping spheres, just as the triangle was made by three intersecting circles. Overall, it comes as an extension of the reuleaux triangle. So just like the reuleaux triangle wheel can be rotated like a circular wheel in a straight line (implying 2 dimensional motion), the reuleaux tetrahedron can roll smoothly in all directions a sphere would (implying 3 dimensional motion). Hence it can be used as an omnidirectional wheel and a flat surface can slide upon it.



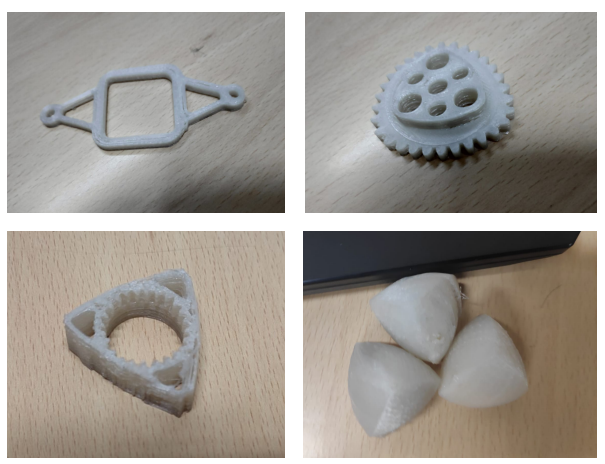
Wankel Engine

The Wankel engine is a kind of an IC rotary engine that uses a triangular rotor's rotatory motion mounted on an elliptical chamber to convert heat energy into a rotating motion without the use of a standard reciprocating piston. Compared to piston engines, rotary wankel engines have a lesser weight, smaller size and more compactness.



Conclusion & Results

In the timeline of our project, we first introduced various types of reuleaux polygons, starting with the reuleaux triangle. We then calculated the general formula for the area and perimeter of a n-sided reuleaux polygon. The applications includes an omnidirectional wheel, which was made by 3d printing the reuleaux tetrahedron. Three of these were used to make a flat surface slide with them easily. Then we modeled a reuleaux gear coupling mechanism, which used a gear made of reuleaux triangle. We also modelled a wankel engine which is driven by compressed air instead of ignition. Also we documented some of the necessary calculations for all our applications.



3D Prints for the projects : a) coupling for the gear b) Reuleaux gear c) rotor for wankel engine d) reuleaux tetrahedrons

Abhinav Gangwar (11901) | Sarthak Sabharwal (11940)
Mentored by : Prof. Shobha Bagai