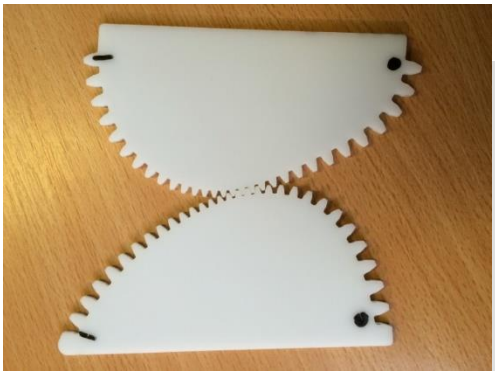
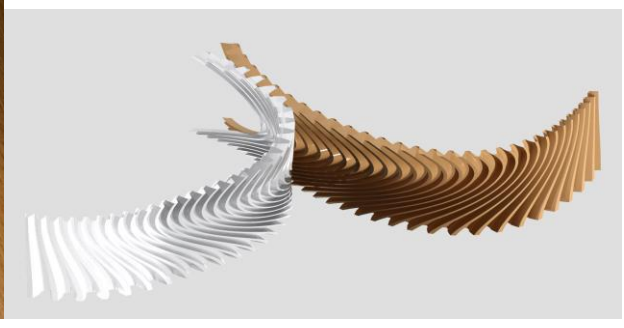
Research summary

The research had two major aims. The first one was to develop an efficient and reliable numerical method that is capable of creating 2D gear geometry with changing ratio. The second aim was to make a research on the possible beneficial applications of these special machine parts. Our conviction is that noncircular gears could be efficiently applied in a broader circle. In our opinion its not widespread use can be explained by the manufacturing difficulties and the time-consuming calculations. The intensive development of the manufacturing techniques however makes most of the noncircular gears easy to produce. The goal was so to eliminate the problems regarding the geometrical calculations and speed up the process. For this we applied a numerical method that enables fast and robust calculations. The first algorithm that was created in Matlab environment simulates the gear-generation manufacturing process. After defining the changing ratio pitch curves with a constant axis-distance, a cutting tool-gear is generated considering the profile parameters. The virtual numerical gear-generation is than carried out using coordinate transformations that result a set of tool-gear curves. The envelope of this geometry is the resulting gear that is determined using a self-developed numerical algorithm. The resulting geometry is than processed in order to make work in CAD environment easier. To make the process simpler a graphic user interface has been created as well.

In order to test the algorithm numerous examples were worked out. We learned that not just changing ratio but changing-axis distance would be as well useful. Besides as the loads change with the ratio, the possibility of changing profile parameters would be essential. Considering these issues a new approach was worked out that is based on the basic law of gearing. The flank-curves are determined using the straight lines of action. This method is faster and enables the application of different profile parameters on each flank-curve. The high calculation speed also makes 3D parallel axes gears possible using a layering method. This new algorithm contains a more advanced pitch-curve generating module that is capable of creating changing axis distance as well. Like the first algorithm, this one also has a graphic user interface. The method was validated by two manufactured examples. The first one is a pair of laser cut 2D gears that have changing ratio, changing axis distance and changing profile parameters on each flank-curve. The second one is a 3D printed 3D pair of gears that also has constantly changing profile parameters in the axial direction.





Publications

1. Bendefy A, Horák P: Cylindrical gears with changing ratio, PERIODICA POLYTECHNICA-MECHANICAL ENGINEERING 61: (2) pp. 130-134. (2017)

2. Bendefy A., Horák P.: GEAR PAIR GENERATION WITH THE METHOD OF TRANSPOSED LINES OF ACTION 14th International Design Conference, DESIGN 2016, pp. 129-136
3. Bendefy A., Piros A., Horák P.Arbitrary vehicle steering characteristics with changing ratio rack and pinion transmission. ADVANCES IN MECHANICAL ENGINEERING 7: pp. 1-12. (2015) Link(ek): DOI