Spring 2017

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William M. Bartholomew
University of Southern Maine

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Instructional Learning Aids for Gear Train Analysis in Machine Dynamics

William M. Bartholomew, USM Mechanical Engineering Student
Mentor: Mehrdaad Ghorashi Ph.D., USM Engineering Professor

Abstract
In this project, a few instructional aids to teach gear train analysis to students are designed and manufactured. The system will progressively be more complex in order to help students understand the concepts first, and then the applications which are based on those concepts. The project involves theoretical, simulation and manufacturing (3D printing or CNC) components.

Introduction
When it comes to gear train analysis there are many concepts that may be difficult to understand without seeing real-world examples. This is especially true when it comes to interpreting a diagram displaying a complex gear train. I only hope to help save someone a little time by explaining what some of these concepts are and how they really work.

Objective
Real-world Mechanisms
• help students visualize abstract class concepts like contact ratio, and gear ratio,
• assist students in interpreting complex engineering drawings of gear trains,
• shed light on the number of degrees of freedom of a mechanism,
• demonstrate Parallel Plane Motion as well as concepts like gear mesh

Methods
• SolidWorks (Design & Analysis)
• Hand Calculations for Computing Gear Ratios
• Manufacturing by the use of Computer Numerical Control (CNC) on HDPE Plastic
• Assembly of the Mechanism
• Comparison of the results using various simulation, experimental and theoretical methods

Results
The top two figures simply show what a real-world mechanism might look like compared to its technical drawing. The rotating arm is what separates this mechanism from the mechanism in figure 5 which has two fixed gears. Figure 3 is a 3-D version of the Levai L-type epicyclic gear train. This particular model has a gear ratio of 1:3 which amazingly produced an oscillating output! Nikola Tesla was fascinated by the number 3 which is fundamentally why alternating current works like it does.

Conclusions
• Our way of making a choice is similar to the output of this gear train in that we oscillate back and forth until we make a decision
• Gear ratio of 3:1 produces an oscillating effect

Acknowledgements
I would like to give thanks to all of my fellow students who continue to inspire me. I would also like to thank Dr. Mehrdaad Ghorashi, who truly is an amazing professor dedicated to teaching students as well as learning from them. I would also like to thank Dr. James Masi for always being a positive influence to all students.