“Plunger at Location” Sensing

Overview
The plunger lift systems used in marginal gas wells lack a method of accurately and cost effectively determining the location of the plunger within the well. Determining the location, or at least detecting he arrival of the plunger at the bottom hole bumper, could increase cycling frequency, thus saving valuable production time in the well. Currently, the plunger time must be estimated, and additional time must be taken to ensure that the plunger has reached the bottom before reopening the well; failing to do so can result in damage to the lubricator.

Objectives
The team was given the task of developing three concepts for determining the arrival of a plunger at the base of a well to aid in gas well optimization. Finding a continuous means of sensing was a secondary goal (time permitting).

Approach
- The team met with Well Master via Skype to define a more detailed set of customer needs. These included (but were not limited to) a low unit cost, no wires in the well, possible application to non-Well Master products.
- The members of the team split up to research as many sensing techniques as possible. Once we arrived at a set list, we used a AHP comparison of needs and a Pugh chart to arrive at the three most applicable concepts: a downhole mechanical signal generator, on-board mechanical signal generator, and use of waveguide analysis (applicable to many situations).
- We reviewed patents in order to determine which technologies we could not use for our concepts; the patents also gave us an idea of technology already in use that we may be able to apply in a different way.
- We created models in SolidWorks which we were then able to use to print a plastic prototype (rather than the steel the device should actually be made of) of the on-board device from the 3D printer in the Learning Factory.

Outcomes
- We were able to develop the on-board device most fully, but it still requires a great deal of work and testing (which will be done by Well Master if they choose to continue development).
- Further research (beyond the scope of this project) is needed for the waveguide analysis to determine a cut off frequency for acoustic or other signals used in the well.
- For this project, we were able to apply an existing technique (acoustic) in a new way that does not infringe on any patents, and will cost significantly less.