Sensor Feedback Device for Guided Needle Insertion

Overview
The current methods for training medical residents to perform catheterizations do not accurately simulate the experience on a live patient or provide reliable muscle memory. The result is that many patients are injured by faulty catheterization procedures done by emerging medical residents. To create a better training system that provides haptic feedback to the user, force and orientation data is required to mimic the feeling of live-patient catheterization.

Objectives
The objective of our team’s project was to create a device that would collect force and orientation data associated with performing a catheterization.

Approach
- Discussed project objective with sponsors
- Used the problem statement and objective to derive a list of customer needs
- Proposed several concepts and underwent a selection process to choose the one that best met customer needs
- Created 3D CAD models and conducted finite element analysis on models
- Fabricated several prototypes through 3D printing and machining and improved components until customer needs were satisfied
- Calibrated force sensor to gather data in the appropriate range of needle insertion
- Conducted thorough testing on various tissue types
- Conducted testing using different needle gauges and different handlers
- Generated results by plotting test data; results were assessed for consistency amongst tissue type and user

Outcomes
- This device provided a new way to gather the force and orientation data of catheterization
- The collected data showed the necessary accuracy and consistency for reliable data
- Resulting plots showed characteristic puncture points and force spikes associated with catheterization
- The sponsors will take the device on to conduct further testing by trained users
- The resulting data can ultimately provide accurate simulation of the needle insertion experience.