Virginia Tech
Chris Williams (Advisor): cbwill@vt.edu

Customized Golf Grip

Cam Chatham: cchatham@vt.edu
Andy Cohen: acohen8@vt.edu
Jake Fallon: jakefallon59@gmail.com
Eric Gilmer: lgeric@vt.edu

Problem Statement

The golf club grip is a critical aspect of golf; it is the only interface between the player and the golf ball, and can have a significant impact on a player's performance. Additionally, emerging playing styles such as the single plane swing require a unique grip. These swings can reduce injuries for the elderly and produce more consistent performance for experienced players.

Solution and Benefits

We created personalized grips to facilitate these swings and allow players to practice without a professional's supervision. The grips are custom-fit to each player by an on-site golf professional using clay or another amorphous material. This clay mold is then sent to our facility, where we scan it and convert the scanned point cloud model into an STL file. We then create a cavity in the center of the file to accommodate the golf club's shaft. Finally, we print the file in a thermoplastic urethane (TPU) resin and mail a set of three grips to the customer.

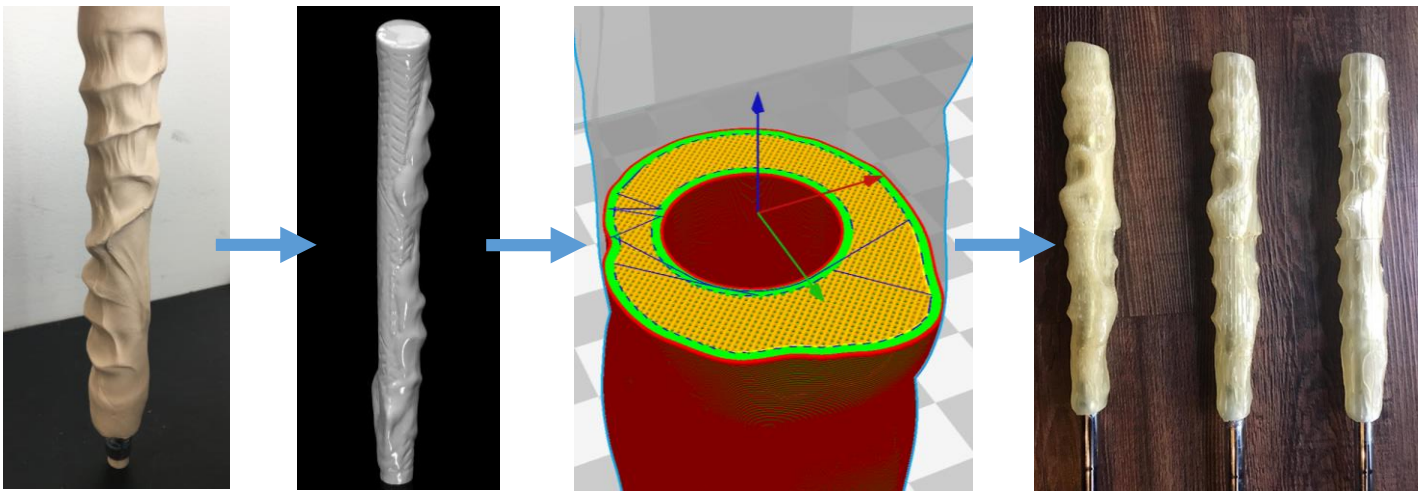

Figure 1 – Process summary. From left to right: a clay mold is made, an STL is created from the scanned mold, a cavity is added for the shaft, and a set of grips are printed.

Material and Machine Selection

The resin we selected is a TPU that has a variety of desirable qualities: it has been approved by the FDA for tissue contact for 30 days or less; TPUs in general are soft yet durable; Texin TPU can be cheaply purchased in pellet form and extruded into filament; and the specified shrinkage (.008 in/in) is low, permitting high-fidelity prints. The material extrusion process can print this material relatively cheaply and effectively, so we selected a machine of this type. We chose the Monoprice after finding that its low upfront cost was amortized far more quickly than higher-priced models' since its speed was comparable and stringing between parts made batching impractical.

Table 1 – Summary of print parameters for a set of three grips

Printer	Monoprice Maker Select Plus
Material	Texin RxT70A TPU
Volume	716.8 cm^3

Suitability for DDM

Additive manufacturing can quickly print customized grips far more cost effectively than via traditional methods; subtractive methods such as 3-axis milling would be unable to produce challenging features such as the overhangs between fingers on the grip, and creating injection or sand molds for each customer would be extremely costly. These mold costs would also be problematic for both blow molding and thermoforming. With additive manufacturing, however, complexity is free. The speed of production offered by additive manufacturing also allows for a short turnaround time; the print can be started as soon as the part is scanned and the STL file is sent.