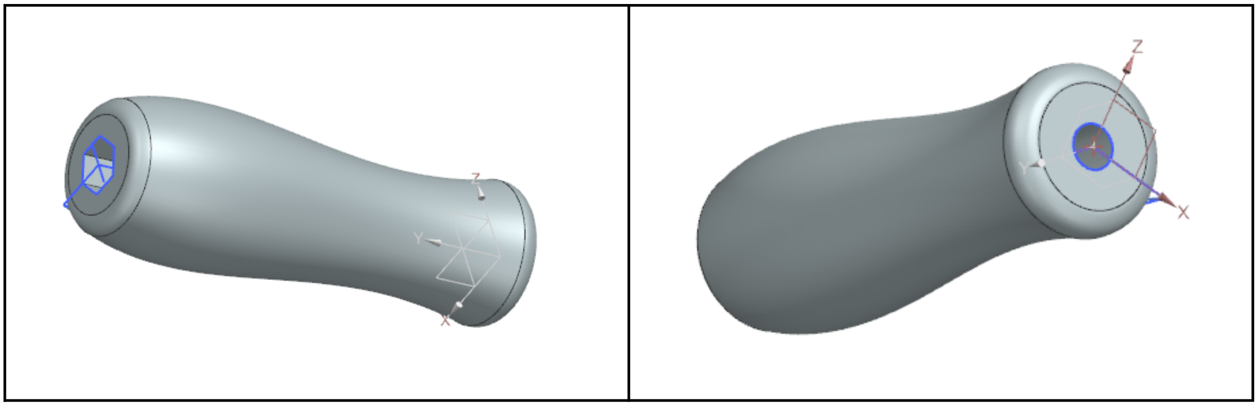

Figure 1: Original Part (Named “Tool Mount Original” in Files)

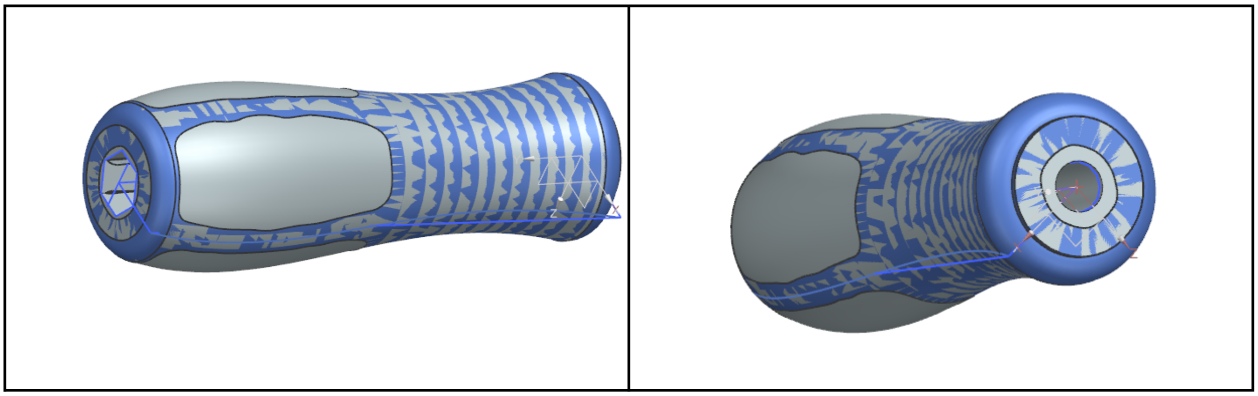

Figure 2: Optimized Part (Named “Tool Mount” in Files)

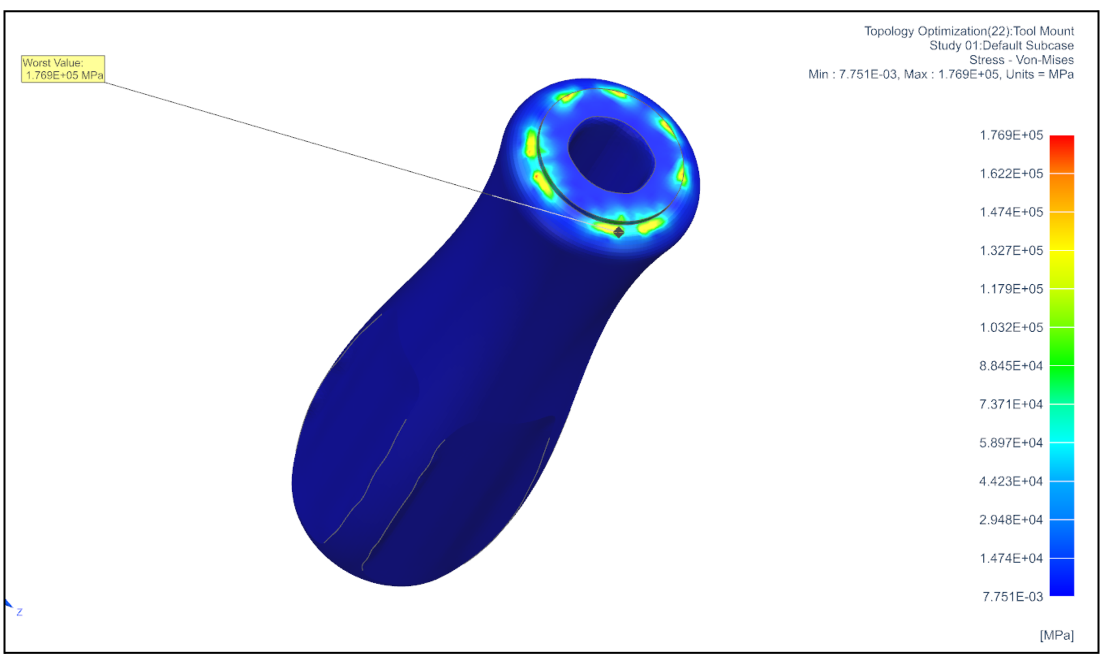

Figure 3. Stress Result

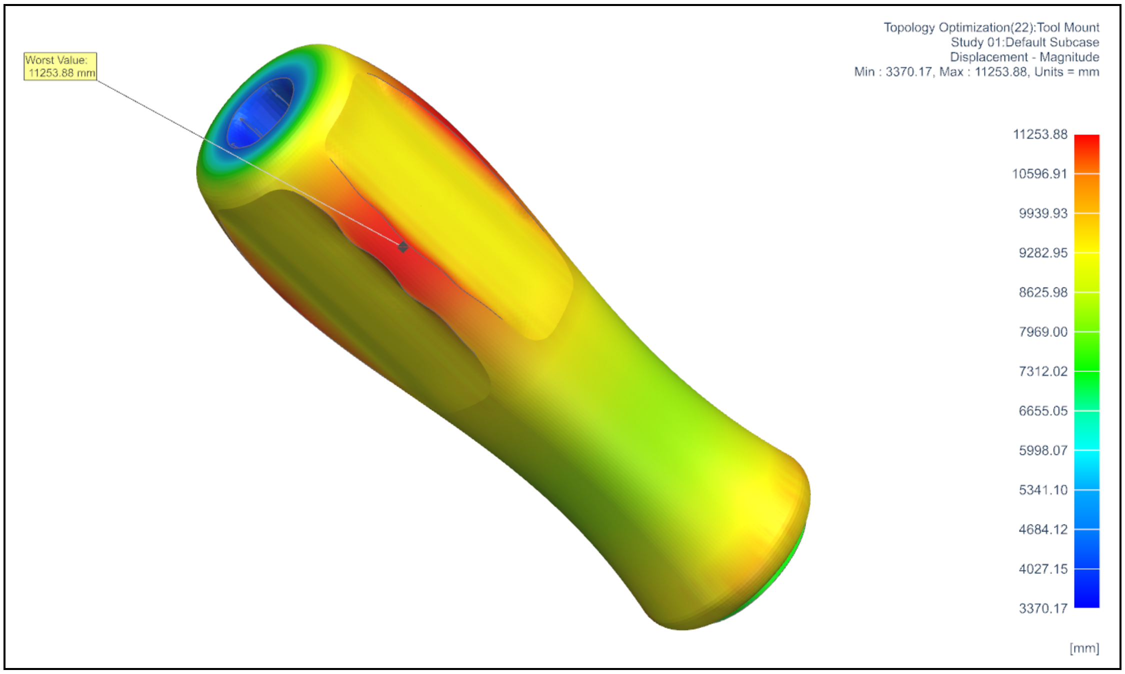

Figure 4. Displacement Result

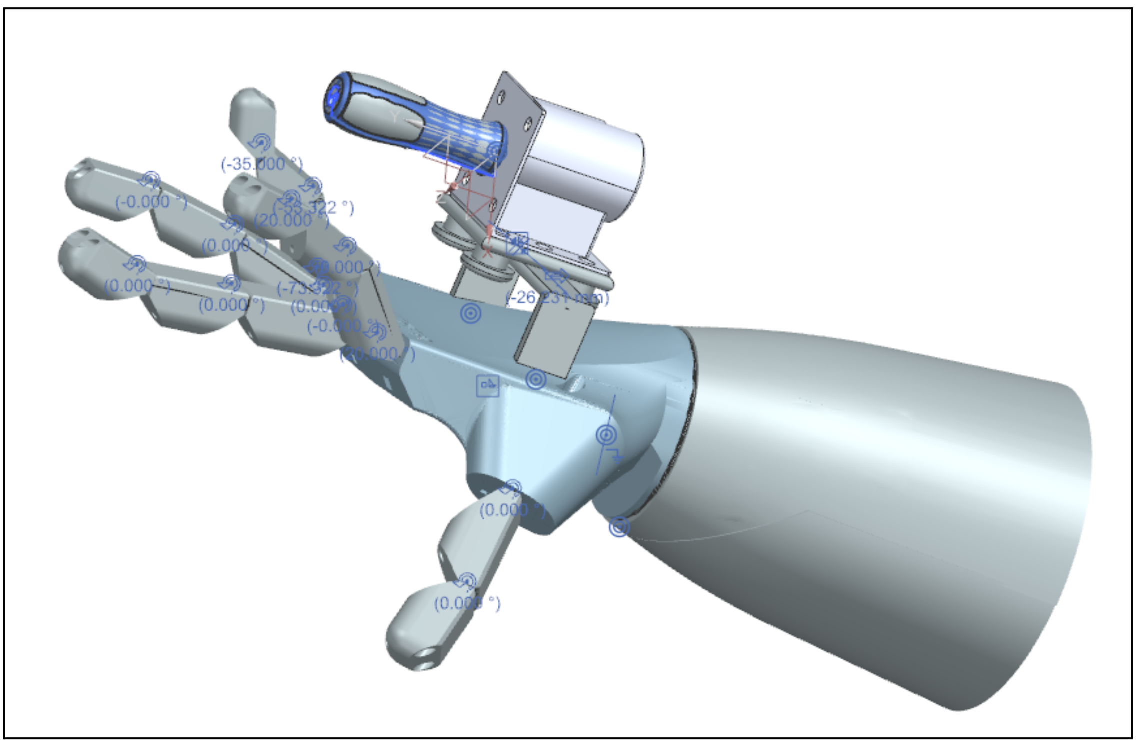

Figure 5: Final Assembly

Generative design allows one to set an optimization objective and can explore design spaces quickly. This process enables the identification of optimal solutions that meet specific criteria, leading to more efficient designs.

For the tool mount component selected, stiffness is important because it has to attach to a rotary motor shaft and follow the motor's motion without slipping while holding and utilizing a tool bit on its other end without deforming or bending.

Some of the steps taken in the generative design process include setting the objective to maximize stiffness, selecting the design space as the tool mount and applying shape constraints. Shape constraints are vital, because in order for the modified part to fit back into the assembly, certain dimensions need to be maintained. The circular and hexagonal extrusion on either end of the part were constrained. A pinned analysis constraint was added on the extruded cylindrical surface to indicate the axis of where the motor would spin the part. The analysis loads incorporated include a torque where the tool mount would fit into the motor and a 150N force in the hexagonal extrusion to imitate the force on the mount from the tool bit, once assembled and in use. The torque of a standard drill when driving medium sized screws ranges from 15 Nm to 35Nm, thus 35N was set as the torque value in the simulation. Gravity was also introduced as an environmental load.

In order to add a torque and a pinned constraint, 2 separate cylindrical surfaces are required, so in order to accurately simulate the usage of the part, an extra extrusion was added to the original part design and the topology optimization was redone.

The optimization constraints added included a max stress limit, set to have an ultimate tensile stress of 90% and a max mass limit set to ~0.0108kg when the part was originally at a mass of ~0.0217kg. The final part generated visually complied by the latter constraint by reducing material. According to the stress result study, the highest points of stress are where the mount is pinned with the worst value being 1.769E+05 MPa. This occurs at very specific and targeted points. Majority of the part experiences a stress of 7.751E-03 MPa which is a low and therefore a good result.

One limitation of the NX generative design tool is that it limits how many times certain features and surfaces can be used, creating limitations in how accurately a part can be represented in the simulation. For instance one surface can not have both an analysis constraint and analysis load. Additionally, certain features including shape constraints of the same type cannot be used more than once, regardless of whether they are used on separate surfaces making it difficult to both accurately simulate the part and set constraints where necessary.

The final part realistically could be used in the final design. When considering the manufacturability of the part, the original design contains a B-Spline curve which requires more precision to manufacture than a design that has more straight forward shapes. The final part generated also has curves, and also does not have as much symmetry as the original part, creating even more manufacturing difficulties.