Requirements for “Device stays stationary without input”:

The “global” design requirements table separated the overall device requirements into three main categories: functional, interface and ergonomics. Logically, the specific requirements for any of the devices functions should not interfere with these global requirements. In fact, if the implementation of a certain concept for a specific function, such as “device stays stationary without input”, hinders the overall product in achieving one of its global design requirements, it is considered to be a drawback of the concept itself. For that reason, the specific requirements for the function “device stays stationary without input” are directly deduced from the global design requirements table, and can also be separated into functional, interface and ergonomics groups:

**Functional:**

* Concept must prevent the cutting tool from falling towards the work piece when the robot lacks input
* When an input is present into the robot, concept must still allow the robot to fulfill the core functional requirement of providing a 3D haptic interface.

**Interface:**

* Concept must be capable of being sterilized without deteriorating of its components or hindering any of its capabilities
* Any un-sterilizable components of the concept must be completely sealed and contained in a sterilizable encasement

**Ergonomics:**

* Concept must be light-weight, weighing less than 3 lbs (considering the whole robot weight should be less than 10 lbs)
* Concept must have a size less than 25% of the link or robot arm it will be implemented on.
* Concept must add a resistance to user-directed movement less than a virtual weight of .5 kg (considering the virtual weight of the whole system should be less than 1 kg)

Evaluation Criteria for “Device stays stationary without input”:

Similar to the requirements mentioned above, the evaluation criteria for “device stays stationary without input” can also be directly deduced from the global evaluation criteria for the device as a whole. It can be seen from the user satisfaction graphs generated previously that a sharp increase in user satisfaction occurs with the decrease of total device weight, virtual weight, and size. In terms of the specific function “device stays stationary without input”, this effect is almost identical to a decrease of concept added weight, concept added virtual weight/resistance, and concept added size. Thus these portions of the concept design are considered to have high impact on the success of the concept. The most prominent portion of the concept that has a lower level of impact is the sterilizability of the components of the concept. This is still an important global requirement, but for the purpose of this specific function it is less important. Finally, there are no detailed evaluation criteria for the core functional requirement of the concept (prevent the cutting tool from falling towards the work piece when the robot lacks input), simply because a concept which doesn’t fulfill this requirement will not even pass the “go no-go” test and winnowing process to be evaluated with a detailed evaluation criteria. However, features of the concepts, such as feasibility, simplicity, and cost, are considered to be crucial in the evaluation process.

The following is a breakdown of the evaluation criteria chosen for the function “Device stays stationary without input” and their relative importance.

Weight addition 25%

Virtual weight addition 20%

Size amplification 20%

Feasibility/simplicity 15%

Sterilizability 15%

Cost (predicted) 5%