# A video game system to assess advanced control interfaces for pediatric prostheses

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## Introduction

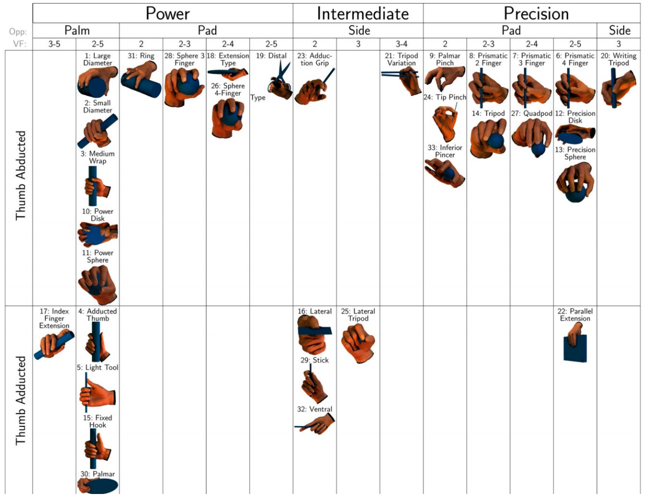
BEAR laboratory is investigating advanced prosthesis control techniques with the potential to dramatically improve the function and dexterity offered by children's pediatric devices. One method we will use to improve understanding is a study of children's muscle behavior while they are moving their hand into various specific positions. To study this, I have created a video game that will require the user to move their hand into different positions and measure the intensity of the movement. The video game will take in input from a muscular ultrasound, instruct the young user to make specific grasps, and precisely record the results. The results will be analyzed by a MatLab program written by another lab member.

## Methods

The video game was programmed with Unity3d, the current state of the art game development program. The low-level code was programmed using C#, but the high-level game object rendering was performed using Unity3D's graphical development software. The program was created following object0oriented programming standards so that in the future if new grasping patterns need to be analyzed, it will be simple to edit the code so that the experiment can be altered.

The experiment can test for up to eight different gestures. The eight gestures were selected due to being the most mentioned grasping patterns in recent publications[1]. They are:

1) Prismatic 2 Finger
2) Power Sphere
3) Precision Sphere
4) Lateral
5) Lateral Tripod
6) Pinch Grip
7) Medium Wrap
8) Tripod




T. Feix, J. Romero, H. -B. Schmiedmayer, A. M. Dollar and D. Kragic, "The GRASP Taxonomy of Human Grasp Types," in *IEEE Transactions on Human-Machine Systems*, vol. 46, no. 1, pp. 66-77, Feb. 2016, doi: 10.1109/THMS.2015.2470657.

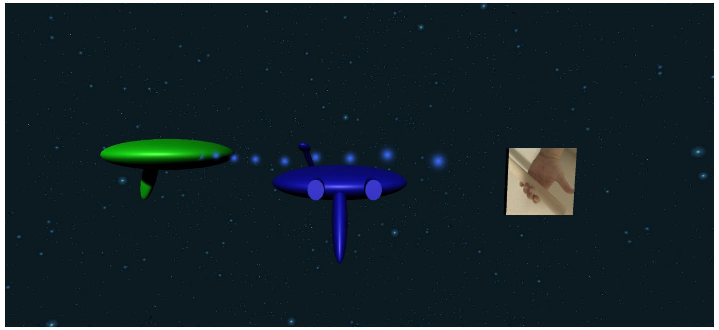
## Results

The game currently functions as a simple asteroid dodging program that can run on any number of operating systems. It can work with up to eight gestures or be set up before the beginning of the game to only work with a subset. It takes in data from keyboard presses now, but this can easily be altered once the ultrasound is purchased. The code is well documented and modular enough to be passed on to new programmers after this project is done.

The grasp selection screen

```
POWER SPHERE
Power sphere held for 9.593018 seconds
PRECISION DISK
LATERAL
Precision Disk held for 10.75897 seconds
Lateral Tripod held for 0.2010498 seconds
Tripod held for 0.5848999 seconds
LIGHT TOOL
Later held for 786.3383 seconds
Light Tool held for 795.0385 seconds
Later held for 803.2014 seconds
Later held for 804.4875 seconds
LIGHT TOOL
Later held for 805.1537 seconds
```

An example of the results to be sent to MatLab



The user must perform the specified gesture to respond

## Future Directions

The video game currently responds to keyboard inputs symbolizing hand motions rather than the hand motions itself. It will have to be programmed to work with a muscular ultrasound device before the experiment can be run. This will likely be done by programming the ultrasound to write to a document which will be read by the Unity3D generated video game. The experiment will hopefully be performed this winter.