Robotic systems nowadays are all around us and interact in many aspects of our everyday lives. For example, many homeowners use robotic vacuums and lawn mowers as a convenience in their homes. Robotic components are used to assemble the cars that many of us drive. However, in the near future there is a push to make these systems more and more interactive with humans. This area of research is known as human-robotic interaction (HRI). Interaction with real people is a difficult task, and much more complex than the simple, monotonous behaviors most robots perform today. Assistive technologies such as those to help the elderly require a delicate, refined process, and this is what has made HRI a large area of research. Its impact in future applications will be great.

In my research, I will study human methods for grasping arbitrary objects and attempt to generalize and apply them in robotics. I will be using the Barrett Robot Hand and the Whole Arm Manipulator (WAM). This is a robotic arm/hand with a similar range of motion to that of the human arm. For reading human input, I will be using sensors such as the stereo camera. The goal of the project is to build and extend from current work in robotic grasping. I hope to create a system that will demonstrate a robot which can both utilize and build off of human behavior to determine the most secure configuration for grasping an object.

Much research has been done in this area in the past, but there is still much work to be done. For example, there is database available currently which describes motion planning for different robotic arms, and recently one called the Interaction Capture Database (http://interactioncapture.org/) has been created with the same goal in mind for robotic grasping. We will be using this database to test and elaborate on different grasping configurations using the WAM arm and objects of different geometries.

Once we have completed this, I hope to demonstrate that the robot can collaborate with a human to accomplish some task. Collaboration plays a huge role in any application of HRI, since many times the human will have the need for robotic assistance in achieving some goal. Take, for example, a robot which could collaborate with a human to lift a piece of PVC pipe. The robot must first analyze the geometry of the object, next determine the most appropriate grasping technique, and finally respond to human behaviors to lift the object to an appropriate height. My research will hope to show that a robot could effectively apply itself in this collaborative technique.

There are several experiments that I will be working on in my research to accomplish these goals. First, the robot must have basic sensing capabilities. To begin with, the geometries of objects will likely be pre-programmed, but in the future the robot will need to assess an object with sensory devices. Trials could be run to ensure that the robot can appropriately determine these geometries. Next, I will observe human behaviors in grasping an object, and attempt to recreate these grasps using the WAM and Hand. Different techniques could be evaluated based on whether an object slipped or whether the robot had difficulty reaching a certain orientation. The third and final set of experiments would show that the robot can now learn to collaborate with a human to accomplish a task. For example, the robot in the example above could collaborate with the human to pick and place an object.

HRI and robotic grasping is a promising field for improved robotic automation in the future. There have been many efforts at robotic grasping in the past; however, it is a difficult area and research continues in the field. We would like to improve on the efforts made in the Interaction Capture Database, and hopefully develop generalized solutions for grasping arbitrary objects. In my work, I hope to push forward in the field of robotic grasping and collaboration with humans.