Articulating Hand for Aid in Biologically-motivated Design of Functional Prostheses

19 Apr. 2012

Joseph McBride
Nonlinear Biodynamics Laboratory
BME599: Sim./Model’g Human Movem’t
There are a variety of issues facing designers of functional hand prostheses

What functions should the prosthesis be capable of performing?

What DOF are required?

What muscles/mechanisms are required to achieve desired DOF?

What forces/torques are required?
One means of addressing these issues is to use biological observations of the natural human hand.

How does the hand accomplish the desired tasks?

Observe articulation & forces

Use observations as starting point & goal of design
One important function desirable of a articulating prosthesis is grasping of round objects

Ball grasp

Requires many DOF
The human hand has many DOF which allow for thousands of functions.
Current articulating hand uses hinges and universal joints
Developing biological hand model required the inclusion of muscles

Wrapping

Via pts
Desired kinematics were determined experimentally and curve-fitted.
Inverse dynamics was used to determine the moments about various joints.
Muscle forces were determined using Plotting tool in OpenSim
Results suggest that all muscles in the hand significantly contribute to movement in a ball grasp.

**At least all** DOF used in this model are required to perform a ball grasp.

Forces/torques are small, but maybe larger for denser materials.

Flexors and extensors do not necessarily work opposite each other—cannot combine into one mechanism.
Results from the current model are not conclusive due to limitations

Realistic masses

Elastic ball/contact surfaces

Coupled motion constraints due to tendons/ligaments
Future work will involve determining forces during other functions

Staff grasp

Sign language

Determining function based on EMG
Questions are always welcome