Objective

CTO Engineering Characteristics

- Strength
- Accuracy
- Simplicity
- Manufacturability
- Maintainability
- Exterior Aesthetics
- Visual Realism
- Servos
- Physics
- User inputs force to cyclic stick.
- C100 motor provides feedback.

Concept Generation

- Pin Connection
  Adds a bolt to improve torsion resistance
- Triangle Support
  Transfers load and restricts torsional motion with added rod
- Solid Connection
  Solid piece prevents torsion in connector rod
- Clamp Design
  Adds two flanges to squeeze, preventing movement
- Center Support
  Rod bolted inside cyclic prevents any movement
- Cradle Design
  Cyclic is bolted inside square tube, restricting movement

Design

- Connector Tube & Connector Tube Clamp
  • Bolt Used to Prevent Slip in Joint
  • Eliminates Torsional Slip
  • Prevents Slip in Axial Direction
  • Kept Cost at Minimum
  • Reusing Current Parts
  • Near 0 Manufacturing Cost

- Stick Base
  • Center Support Bar Eliminates Fore/Aft Play
  • Simple to Machine because of 2 Piece Design
  • Center Support Threads into Stick Base

Prototype and Testing

A 100lb load was applied to the left cyclic handle in both the fore and aft directions

Max Displacement:
- 1.67e-03 in.
- 5.23E-03 in.

Max Stress:
- 2.73e02 psi
- 1.65e02 psi

Test Results and Future Work

<table>
<thead>
<tr>
<th>100lb load on the handle in the fore direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
</tr>
<tr>
<td>Max Displacement [in]</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Max von Mises Stress [psi]</td>
</tr>
<tr>
<td>Location</td>
</tr>
</tbody>
</table>

Product Design Process

- Tested simulator to determine where losses in the system stemmed
- Employed QFD steps to develop the scope
- Generated concepts and selected two using the AHP process
- Built and tested prototypes. Compared FEA results from the current system to the improvement designs

Future Work

- Have improvements machined and implemented
- Test the newly modified simulator