QL+ Fishing Prosthetic Project

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Biomedical Engineering

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Introduction:

- Modern prosthetics
  - Break down to easily in water and sunshine
  - Lose their grip and must be adjusted constantly
  - Get cut up from fishing line and fishing tools
- Benefits of a custom, and specific prosthetic
  - Ability to return to hobbies and improve quality of life
  - Based on existing prosthetic with custom fit
  - Higher durability and usability
  - Able to cast and reel fish using either hand
- Specifications for fishing prosthetic
  - Able to survive slashing from fishing line
  - Hold up in the elements of the Florida Gulf
  - Use inexpensive and common materials for repairing
  - Able to hold fishing rods with minimal adjustments

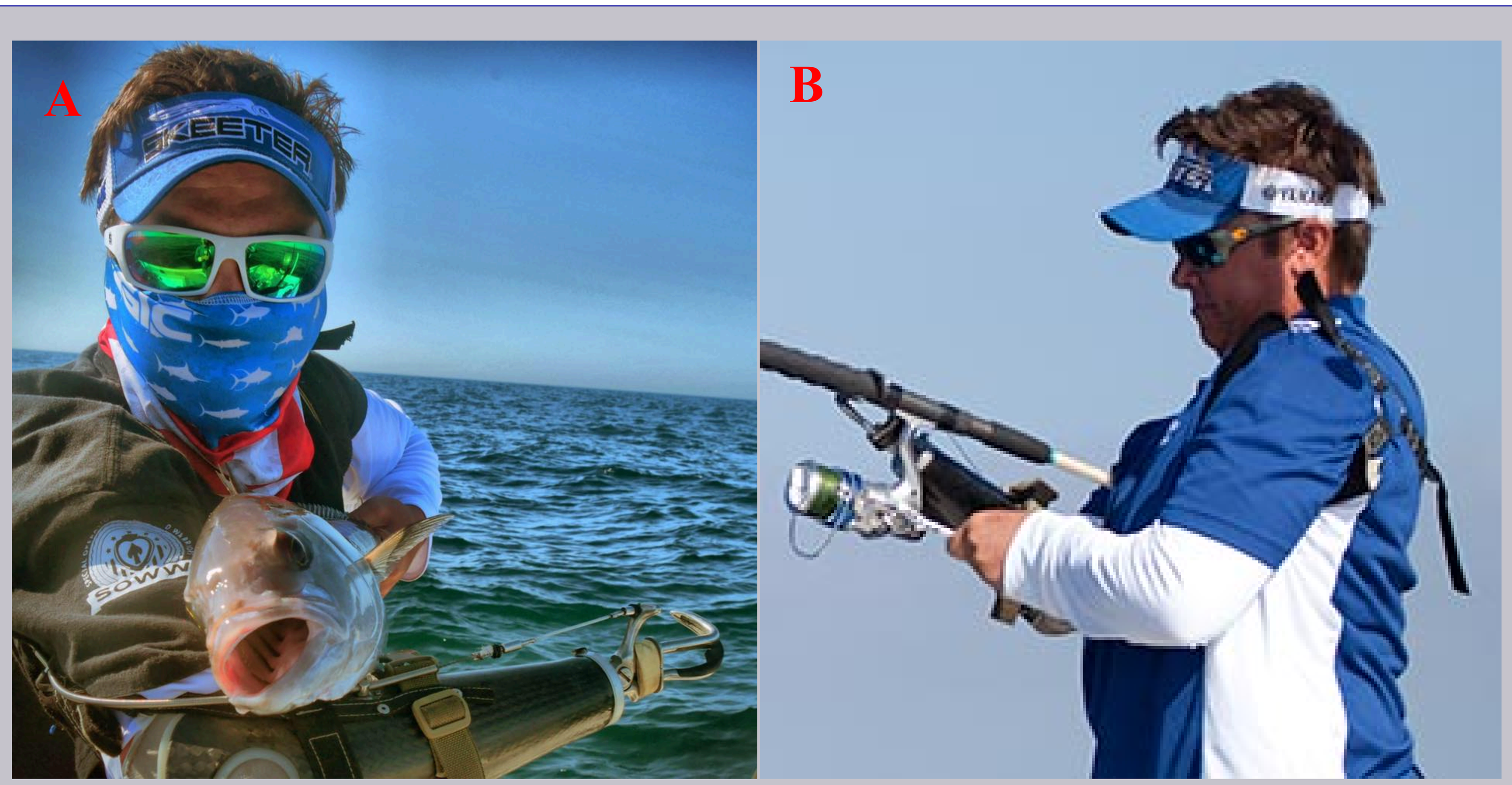

Figure 1: **(A)** Challenger with fish resting on old prosthetic. **(B)** Challenger using rod without straps and using shoulder to brace the rod.

Materials and Methods:

The following is a description of the manufacturing methods and materials used:

- Graphene and sand embedded rubbers were molded and tested as new claw coatings
- Poor strength and hardness lead to graphene rubbers being discarded
- The operating claw on the fishing prosthetic was coated in Flex Seal to protect the claw from being eroded by fishing line
- 2 coats were sprayed on thoroughly from 6 inches away
- Boat canvas selected as improved strap material due to its high durability, water resistance, and strength
- Boat canvas was cut and sewn as adjustable straps on the fishing prosthetic to fixate the rod
- The canvas was affixed to the prosthetic using preexisting screws
- The canvas included industrial Velcro to adjust the tightness

Figure 2: New straps for fishing prosthetic attached to the existing rivets used to secure the body powered claw system.

Results and Discussion:

- The customer's original fishing prosthetic was adjusted to meet requirements
  - Canvas straps replaced nylon straps
    - Canvas is meant to be in ocean conditions, does not lose shape over time, and does not become slippery when wet
    - The customer liked the canvas straps, although they were just a tad short
    - The customer also suggested using only one strap
  - Industrial Velcro allows for ease of use with one hand versus the plastic buckle that was previously used
  - A Flex Seal coating is used to cover the rubber on the hook to create a protective barrier from the fishing line
    - The Flex Seal will need to be replaced after every use, and the customer is content with doing so
    - Flex Seal is a commercially available product
    - The Flex Seal improved the claw durability and grip when testing with the customer

Figure 3: Design team with challenger after testing all prosthetics in Bock parking lot.

Figure 4: Challenger using fishing prosthetic to practice casting and reeling on a grass field.

Figure 5: Challenger using modified fishing prosthetic with coated grips to tie knots and practice tying lures on fishing line.

Conclusion:

- Marine vinyl straps with heavy-duty Velcro were created to help keep the rod in place
- Straps were installed into already existing rivets on the prosthetic
- Flex seal was sprayed onto the hooks to improve durability and grip
- Flex seal will need to be reapplied after a few uses

Future Work:

The following are ideas to further improve the fishing prosthetic project:

- Obtaining an all-metal hook and adding a textured powder coating would allow for grip improvement without the need to add coats over time
- Integrating thicker straps with a ratcheting mechanism would allow for a tighter grip on the rod
- Longer straps allowing for an easier attachment each use

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- Trine University
- Innovation One
- Protoduction 3D
- BAE

QL+ Archery Prosthetic Project

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Introduction:

- Modern prosthetics…
  - Cannot be reliable in aiming nor precision,
  - Are extremely heavy,
  - Are hobbyist level modifications to existing prosthetics,
  - Nonspecific for bow type and handedness
- Benefits of a custom, and specific prosthetic
  - Improved accuracy while shooting
  - Ability to return to normalcy
  - Perfect fit for user based on 3D scans
- Specifications for archery prosthetic
  - Able to quickly remove and attach bow
  - Be extremely light and agile
  - Use as few pieces as possible
  - Able to support draw weight of bow

Materials and Methods:

The following is a description of the manufacturing methods and materials used:

- 3D-scanning was performed by Protoduction3D to record cloud point data resembling the customer's previous prosthetic socket
- This data was imported to SolidWorks as a shell for the prosthetic CAD model to fit the previous polymer socket inside
- The CAD model was printed with polyanaline 12 (PA12) using Protoduction3D's HP Jet Fusion 4200 3D printer
- The 3D print was sanded and improved using a Dremel
- A power drill was used to create holes for the socket's locking mechanism and pressure fitted t-nut
- A steel threaded shaft was screwed into the end of the prosthetic through the t-nut to attach the stage clamp hand
- Steel lock nuts were used to fixate all threaded components

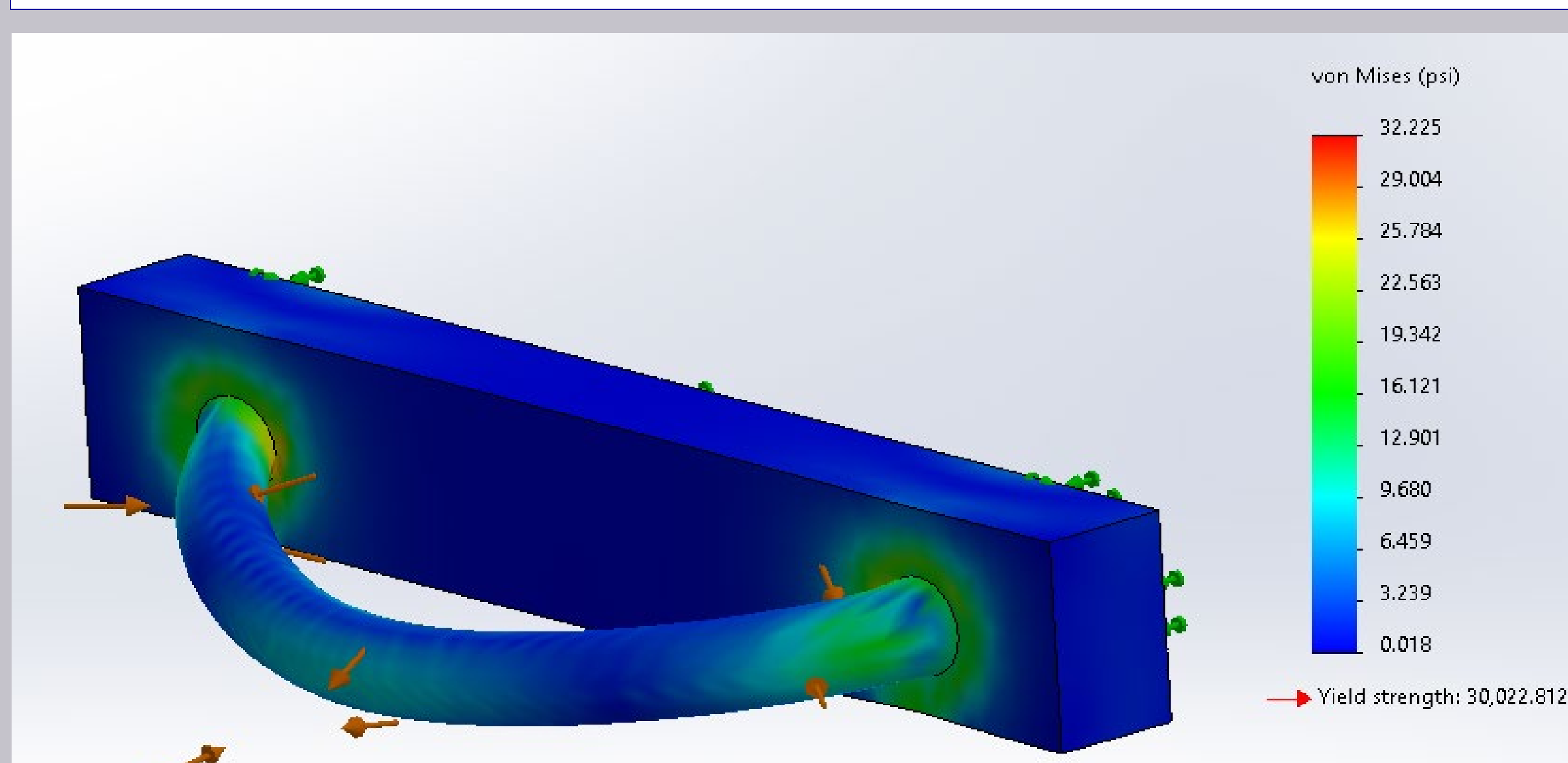

Figure 1: FEA analysis of trusses used in later iterations of the archery prosthetic.

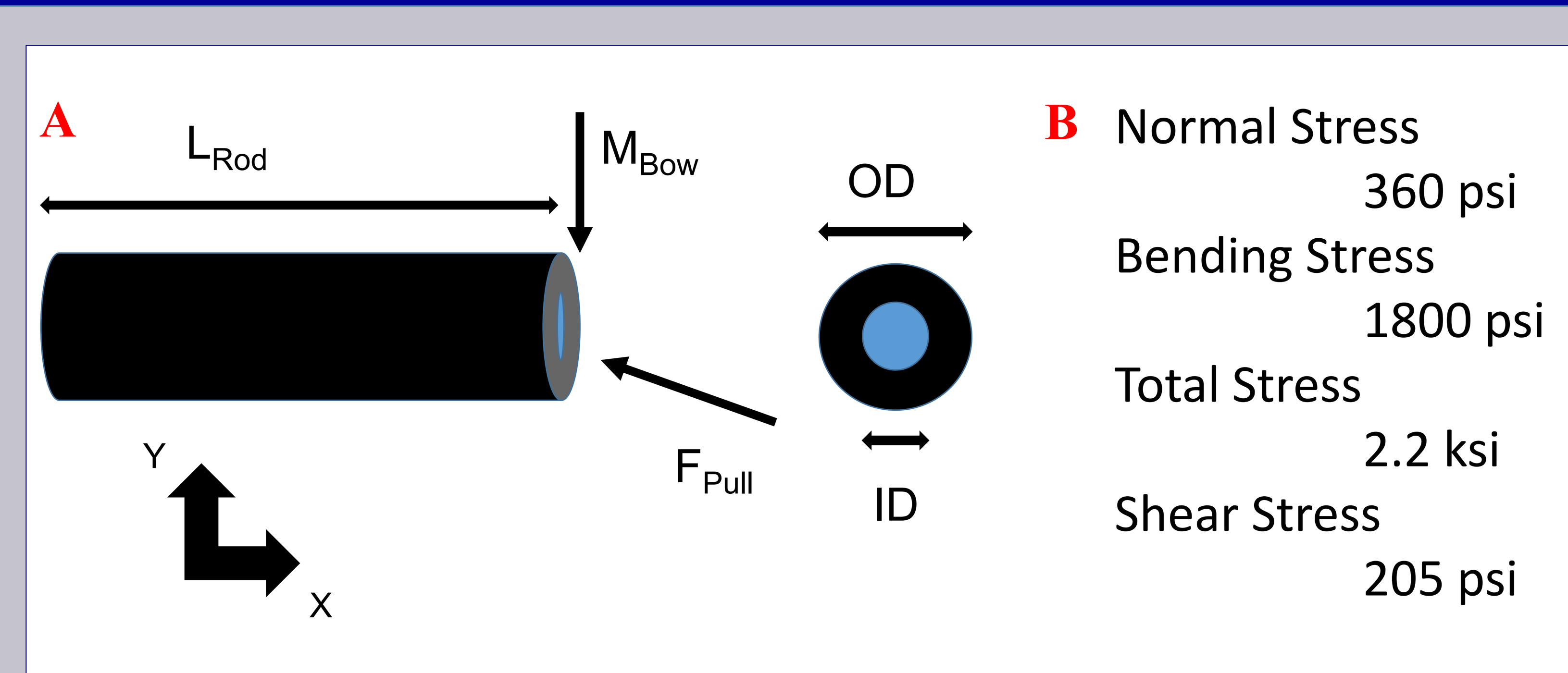

Figure 2: **(A)** Math model of forces experienced by archery prosthetic. **(B)** Solutions to math model with stresses anticipated.

Results and Discussion:

- A completely new design was created to replace the customer's previous archery prosthetic
  - Was designed to be a single piece to relieve any play in the shot
  - Both models weigh less than 6 lbs.
  - The printed material proved sturdy and reliable under force from pulling on the bow
- SolidWorks Simulation on the individual loops shows that it can withstand 75 lbs of force alone
- After testing with the customer, the inner lining of the socket left little room for the customer to fit
  - Material was removed from the white lining so the customer could fully lock into the prosthetic
- The customer preferred the single hand piece versus the two-part hand
  - The bolt was bent in an S-shaped pattern to get the perfect angle, so the customer could hold his arm straight
  - The bent bolt also prevents the string from rubbing on the prosthetic

Figure 3: Close up of archery prosthetic with visible releases and quick release truss.

Figure 4: Challenger taking aim using new archery prosthetic.

Conclusion:

- A 3D printed prosthetic was produced using polyanaline 12 (PA12)
- At the tip of the prosthetic a T-nut was screwed in allowing for the attachment of the hose clamp and U-bolt
- A hose clamp that is threaded in a straight line from the prosthetic was produced as an alternative to the U-bolt
- The use of a Dremel allowed for polishing of the rougher edges and clearance needed to press the release from the sleeve
- Clear coat spray was used to improve resistance to elements the prosthetic may be subjected to

Future Work:

The following are ideas to further improve the archery prosthetic project:

- Designing a slimmer prosthetic would allow for an easier clearance from the bow string on each shot
- The use of a stronger bolt for the attachment would allow for forging and tempering to not be required for strength
- Larger clearance on prosthetic release minimizing dremel need

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- Trine University
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- BAE Systems