Rowing Adaptor for Upper Limb Low Level Impairments (RAULI)

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Introduction

Every year, 2.5% of the amputations in the US are below the elbow. Over 50% of which are in the age range of 21 to 64. Aside from the immediate added difficulty in the amputees daily life, a below elbow amputation leads to a significant reduction in upper body strength. Our project aims at providing the opportunity for these amputees to take up (or continue) the sport of rowing, a physically stimulating activity known for training the whole body and maintaining a strong upper body.

Aims and Objectives

To design a novel adaptive rowing device for single-sculling (i.e. one oar held in each hand), which is capable of:

- Providing a physical connection between the stump and the oar able to transmit the appropriate force between them.
- Providing an automatic feathering (angling of the blade parallel when above the water) functionality.

Design Specifications

Prosthetic:

- Withstand an axial force of 940N.
- Maximum weight (≈3kg) and length should be that of a healthy arm.
- Water-resistant.
- No external power input (FISA regulations).
- Allow the athlete to complete a whole rowing stroke.
- Quick release mechanism for safety purposes.
- No significant irritation throughout a 3hr training session.
- Adjustable prosthetic length (±1.5 cm).

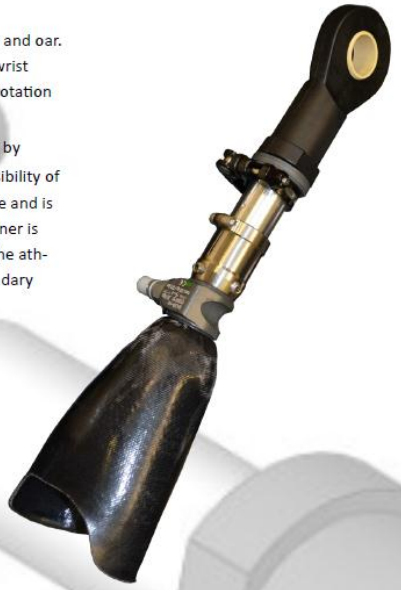
AUTOFOLD (AUTOmatic Feathering Oar Lock Device):

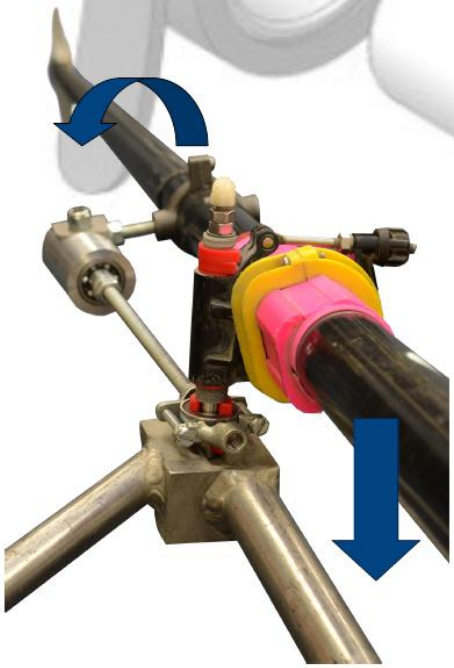
- Must not significantly unbalance the scull (±5° roll).
- Water-resistant.
- Easy installation (simple hand tools).
- No external power input (FISA regulations)

RAULI Prosthetic

The RAULI prosthetic transmits the linear motion between stump and oar. The bearing at the end fits tightly on the oar handle and mimics wrist movement by allowing 66° of horizontal freedom as well as free rotation around the oar.

The length of the prosthetic is adjusted by a mechanism inspired by bicycle seat post adjustment which additionally introduces a possibility of modulation. The fiberglass socket is custom made for each athlete and is attached to the stump via a silicon liner. A pin on the end of the liner is locked inside the socket through a quick release mechanism for the athletes' use in case of capsizing. The seat-post clamp offers a secondary method of release should the quick release fail.





AUTOFOLD

The AUTOFOLD provides automatic feathering as function of height of the oar above the water by coupling a vertical displacement of the oar handle with a ~90° anticlockwise blade rotation.

This allows the athlete to feather when lifting the blade out of the water and to have the oar ready for the catch (when the oar blade reintroduced in the water) at the beginning of the next stroke.

Feathering is essential in competition as it provides increased aerodynamic stability (especially in windy conditions) as the oar blade lies parallel to airflow.

Evaluation

An improvement to our project would be the use of vacuum technology between the liner and the fibre glass prosthetic to create a better grip, hence achieving a higher safety factor. However the liners used in this technology for upper limbs do not feature the mechanical pin necessary for our project. This technology is available for lower limbs and thus may be easily adapted to upper limbs in a further improvement of the project.

For the AUTOFOLD to meet the desired water-resistant design specifications., it should ideally be in light and water-resistant materials (e.g. plastics) rather than aluminium as in the prototype.

Conclusion

Overall the product satisfies the major aims and requirements.

The prosthetic weighs less than a healthy arm and is adjustable to various arm lengths. The design has no external power input and therefore meets FISA regulations.

Furthermore the device is equipped with two levels of release, thereby providing suitable safety functionality in the face of emergencies. The silicon sleeve is often used in Paralympic sports and has been dermatologically tested to not cause irritation.

The AUTOFOLD provides fully mechanical automatic feathering and can be easily installed on any boat., introducing a sense of portability to the project.

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