

Week 10

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Announcement

Upcoming Important Dates:

- Flyer and poster: submit to Moodle (in ppt), due **Today**;
- Final poster: due **Nov. 28** (sent for print);

Organize all the files related to the project, upload to the Onedrive

| Criteria (Max score) | Group | | | | |
|---|-------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Cohesive Scenario (10) | | | | | |
| Clear motivation and communication for the need of the product (10) | | | | | |
| Concept novelty (20) | | | | | |
| Maturity of the prototype (10) | | | | | |
| Application of novel technology (20) | | | | | |
| Poster (content and design) (20) | | | | | |
| Videos and other visual aids to communicate better the concept and working principle (10) | | | | | |
| Sum (100) | | | | | |

- **Motivation**
 - Why your project matters?
 - What makes your approach novel?
 - Strength?
- **Performance**
 - Actual testing data from prototype, Not expectations;
 - Enhance the readability of the plot/table.
- **Design**
 - Highlight how your design helped improve the performance;
 - Justify the design/selection;
- **Summary**
 - Cons and Pros;
 - Future work;





ME-410: Mechanical Product Design & Development

SynchRower

Juliette Hars, Victor Legendre, Soheil Nasiri, Gaston Wolfart, Matthieu Gachet
Reconfigurable Robotics Lab, EPFL, Lausanne, Switzerland

Motivation

For efficient rowing, all crew members need to be perfectly in sync. The usual technique to achieve this is by visually imitating and feeling the movement of the person in front.

Our goal is to improve the synchronisation of the crew by leveraging haptic feedback and muscle memory training, which were shown by previous works [1][2] to have an important impact on learning complex movements.

Additionally, our device will allow each crew member to synchronize with the leader directly instead of with the person in front, thus avoiding delay and loss in performance.





Design



- Foam-based interface for soft skin contact
- 5 passive DOF for enhanced compliance
- Powerful brushless motor & direct drive transmission for perfect backdrivability
- Electronics
- Button
- Audio and visual feedback for effortless mode selection

The button allows for calibration with other devices, and activation of the haptic feedback. The thinner segment lies on the calf and its linear position is adjustable by the user. The motor at the interface of the two segments rotates and drives the leg towards the angle setpoint provided by the leader.

State-of-the-art

Orthoses

Orthofixa
An actuated knee articulation for walking assistance with a control feedback loop to optimize the gait



Rowing smart equipment

Biorower
A rowing boat simulator that simulates water resistance and boat instability, and allows for pace monitoring.

StrokeCoach
Displays pace, stroke count, time, speed.



Summary and Future Development

Our device enables the rowers to get a fast feedback response to help them row in sync. Indeed, we have shown that the delay is short enough (< 10ms). Nevertheless, it would be relevant to do a more thorough dynamic analysis to assess the full capabilities of our device.

It would also be interesting to conduct a study to evaluate how much impact our device has on the training of rowers in real-life conditions.

Performance

- Either wired or wireless communication
- Communication:
 - 200Hz frequency,
 - < 5ms delay
- Response delay < 10ms
- Peak torque: 1.7 Nm
- Volume: 500x100x70 mm
- Mass: 623g



References

[1] Sigrist, R., Rauter, G., Marchal-Crespo, L. et al. Sonification and haptic feedback in addition to visual feedback enhances complex motor task learning. *Exp Brain Res* 233, 909–925 (2015)

[2] Roland Sigrist roland.sigrist@hest.ethz.ch, Georg Rauter, Robert Riener & Peter Wolf (2013) Terminal Feedback Outperforms Concurrent Visual, Auditory, and Haptic Feedback in Learning a Complex Rowing-Type Task. *Journal of Motor Behavior*, 45:6, 455-472

| Achieved | Further improvements |
|---|--------------------------------|
| Working proof of concept | Waterproofing |
| Easy and simple interface | Include battery |
| Great compliance thanks to the 5 passive DOFs | Synchronize more than 2 rowers |

Next Week

- 2nd Mock demo presentation;
- Poster ready for print;