SKILLS

Multimodal Interfaces for Capturing and Transfer of Skill

SKILLS Conference 2011
Montpellier
15th December 2011

Emanuele Ruffaldi & ROW Team

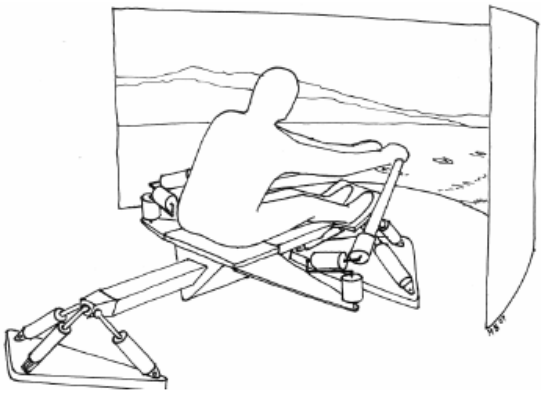
PERCRO Perceptual
Robotics Laboratory

Rowing Training Challenge

Design and development of a multi-modal Rowing demonstrator with the main purpose of skills transfer for training **intermediate-experts** rowers

Out-door

In-door

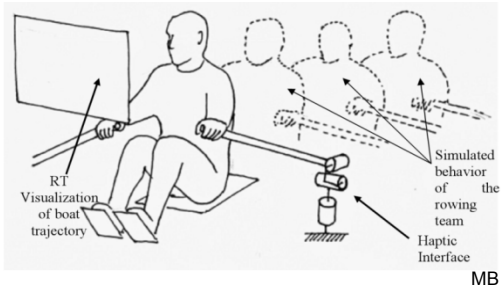


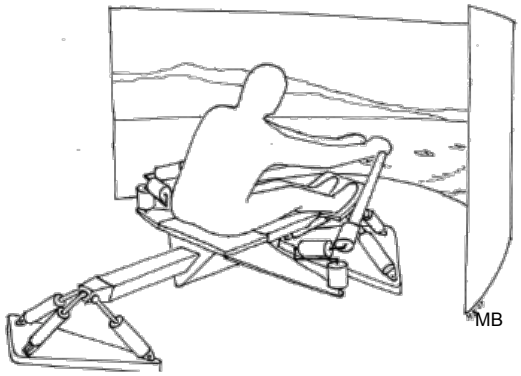
Research Objectives

- **Basic Challenges in VE training**
  - Use of multimodal feedback for complex motor task
  - Use of Virtual Humans for training
- **Design and Validate a Rowing training system**
  - Methodology for Design and Evaluation
  - Architectural
  - Support data management
- **Training of Specific Rowing Aspects**
  - Technique
  - Energy Management
  - Coordination
- **Model the Rowing Skill**
  - Real-Time Scoring
  - Integrated with Training

SPRINT

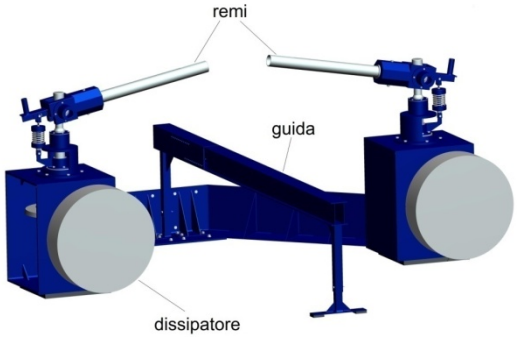
Skills Professional Rowing IN-door Trainer





Conceptual Idea

Immersive Configuration



Platform Design

Training Configuration

Phases of the Work

Task Analysis

Design

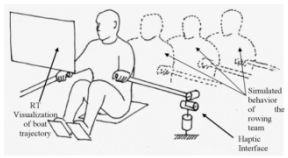
Platform

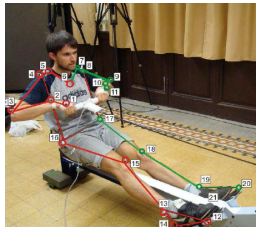
Experiment

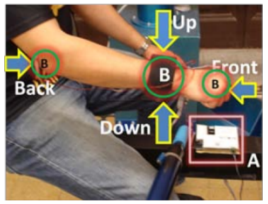
Prototype

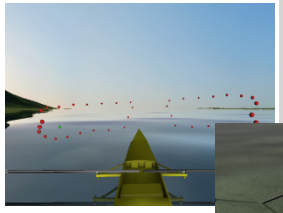
Evaluation

2007 **2008** **2009** **2010** **2011**

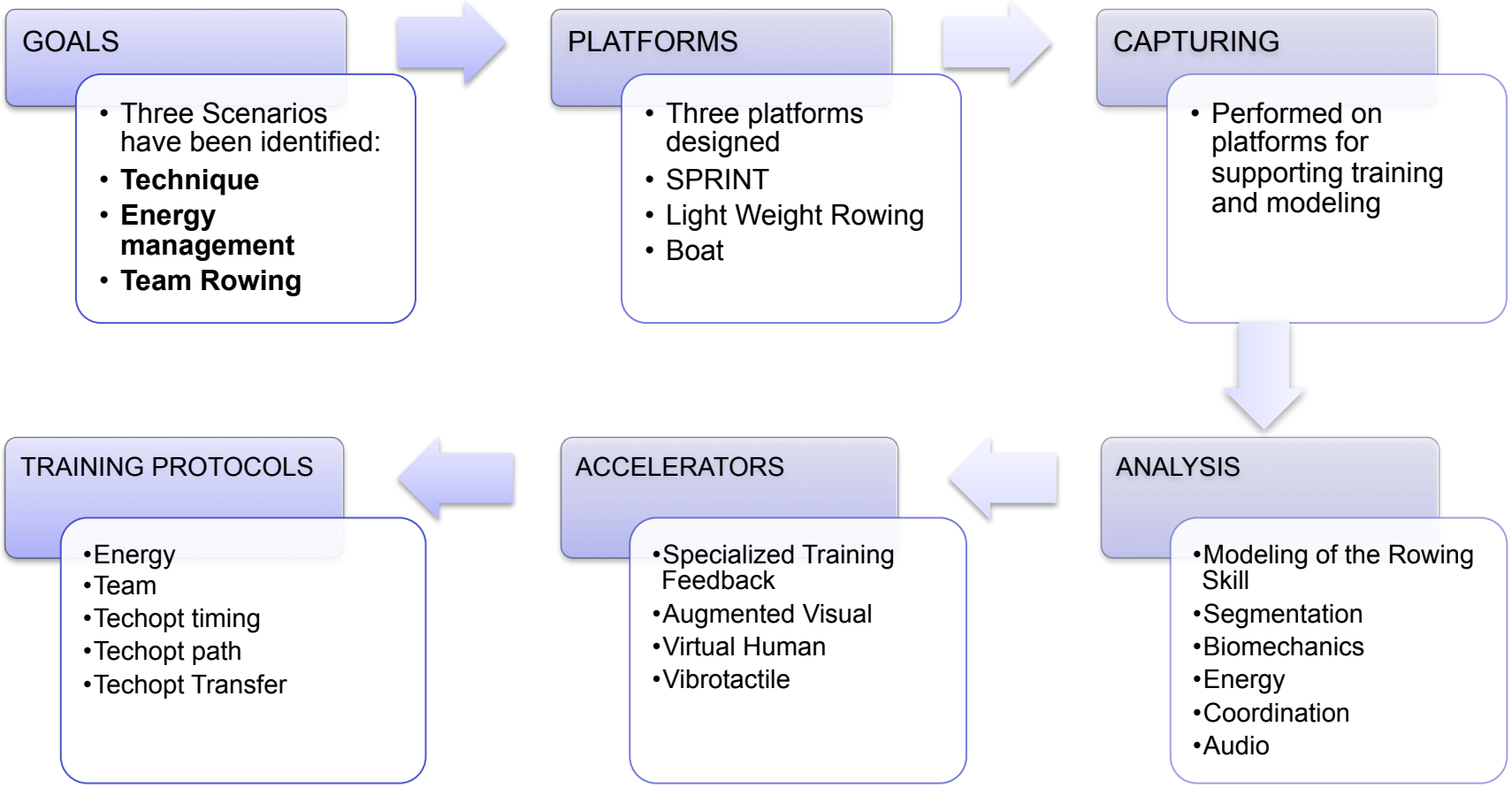








Methodology



Platforms

SPRINT

LWR

Boat

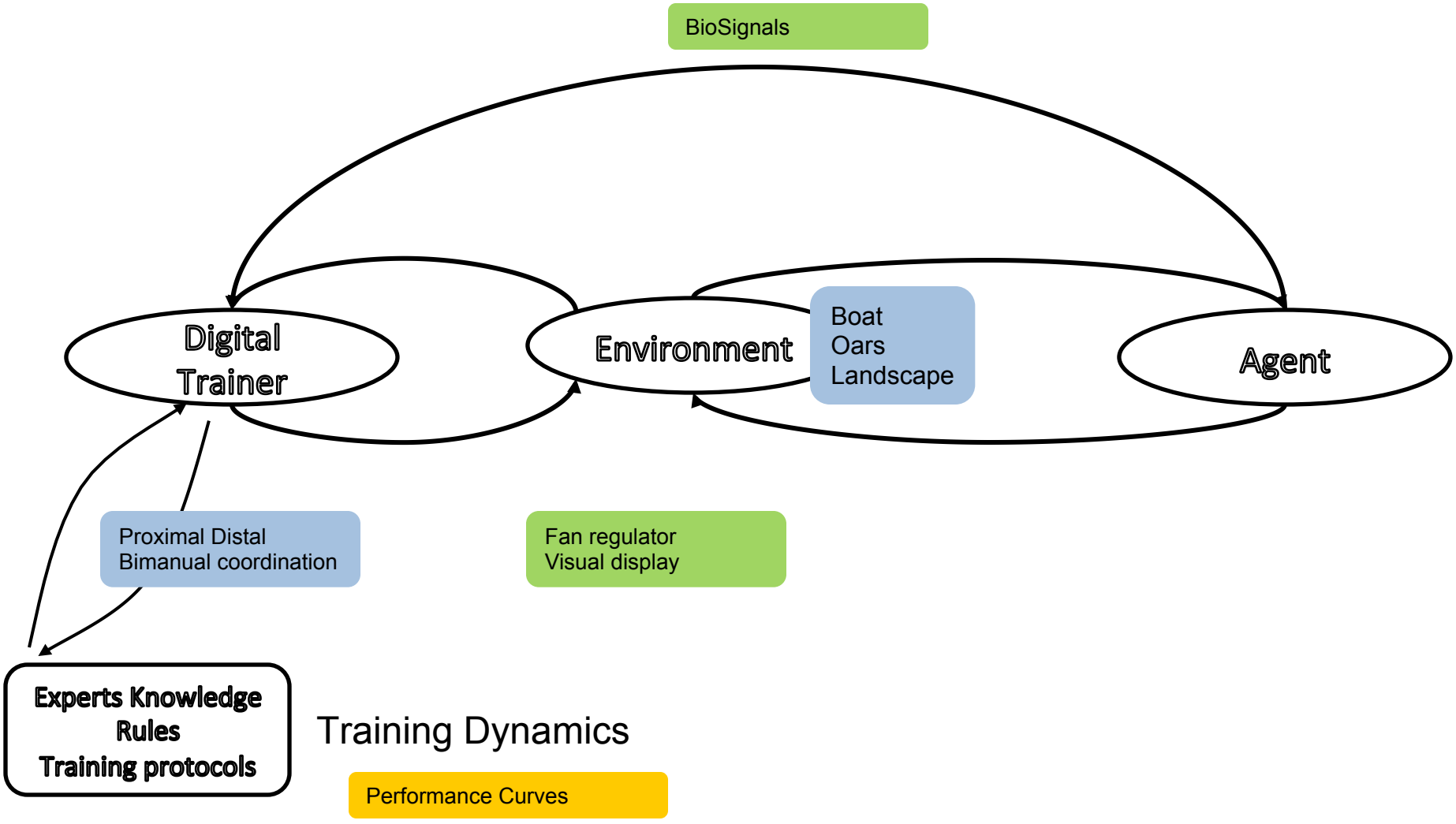
Design Requirements

- **Objectives**
  - Focus on Training, not Simulation
  - Training based Design Decisions
  - *Provide feedback on postures and movements*
  - *Provide feedback on specific sub-goals*
- **Kinematics**
  - same movement of outdoor rowing
- **Dynamics**
  - water **resistance** and **entrance**
- **Training Features**
  - Scull or Sweep with same Device

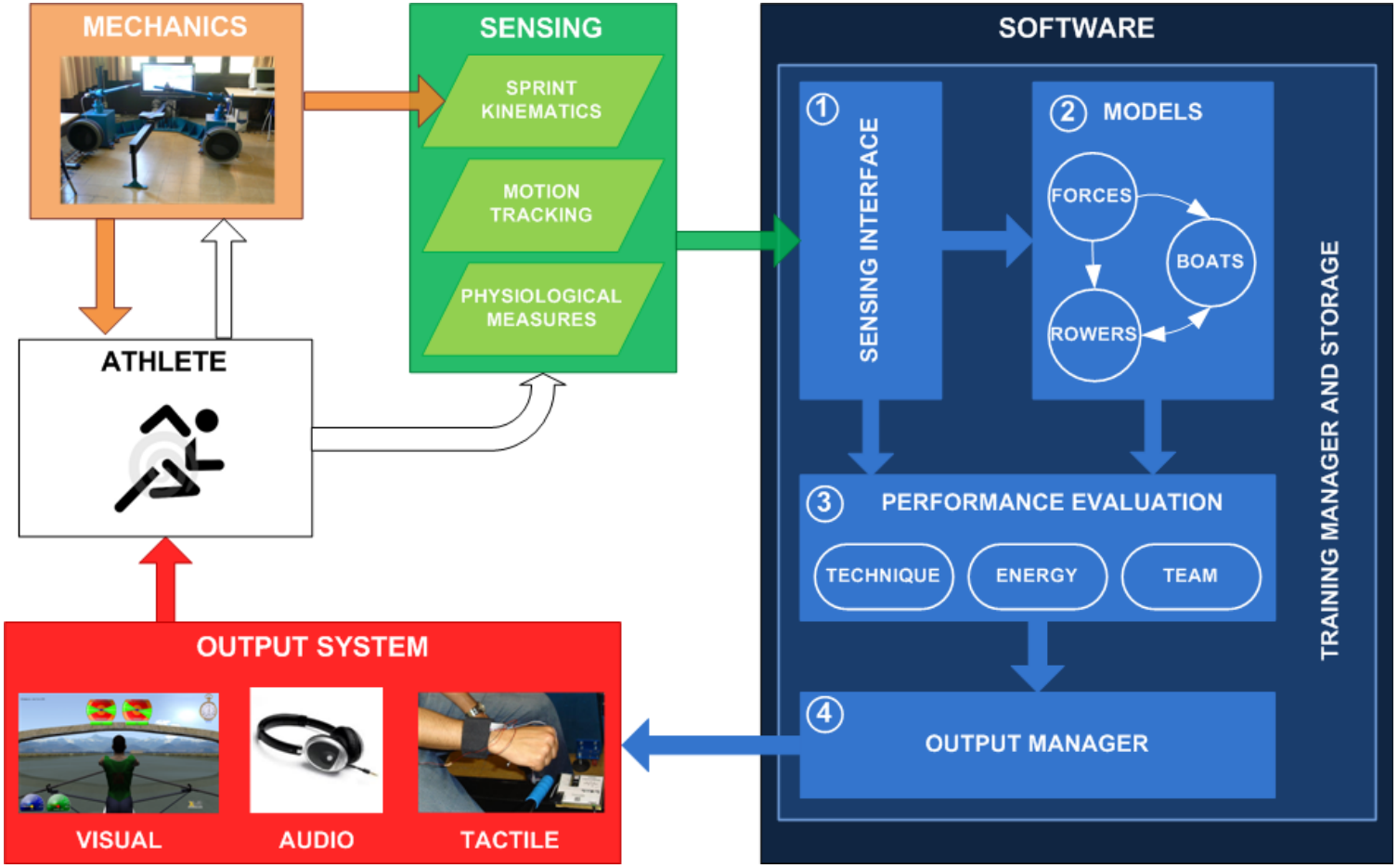
Design Method

- **Design Information**
  - From Manuals
  - From Coaches
  - From Expert Captured data
- **Validations and Refinements**
  - Experts (Questionnaire)
  - Training with Novices
  - Training with Intermediate

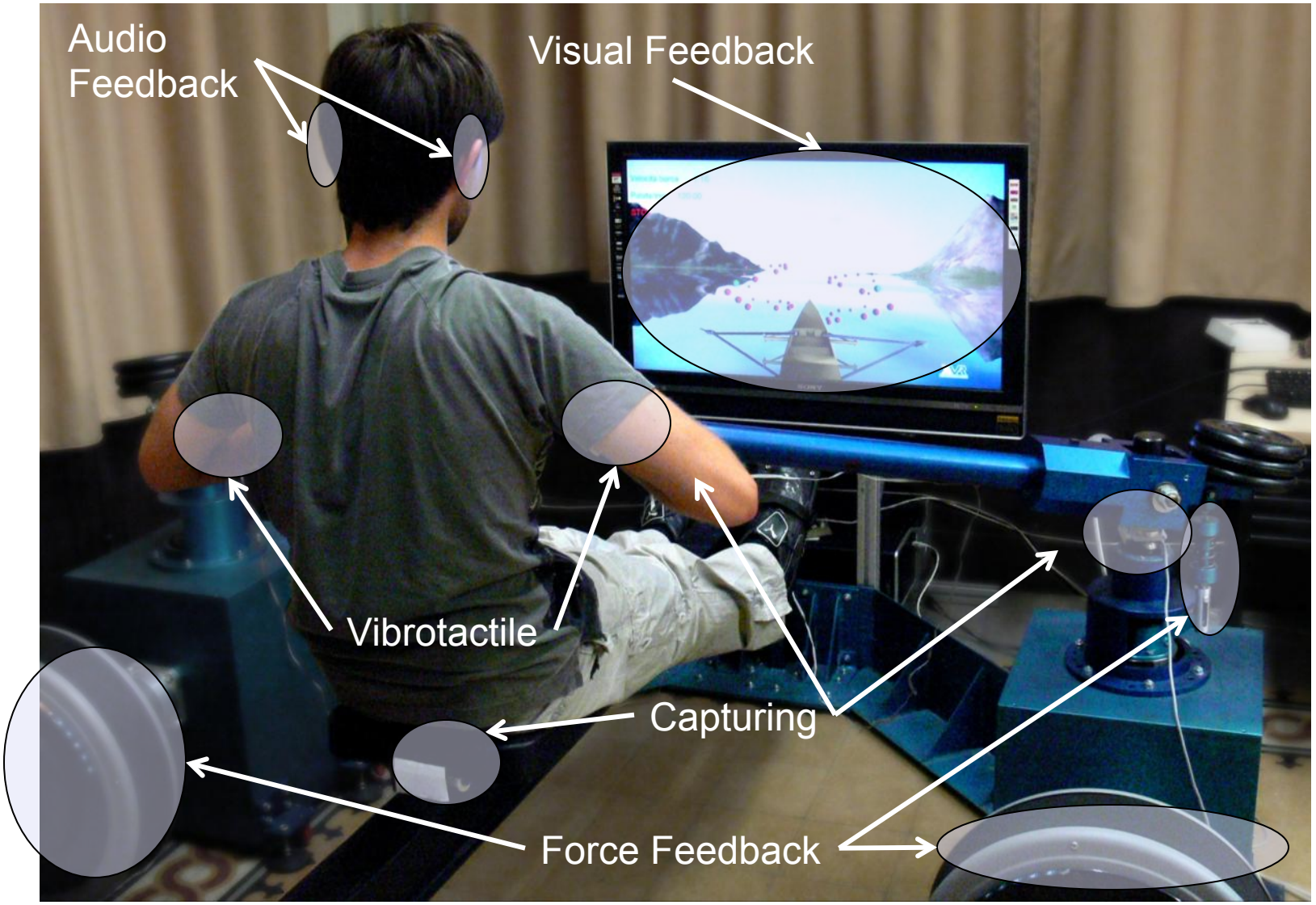
Information Processing Model



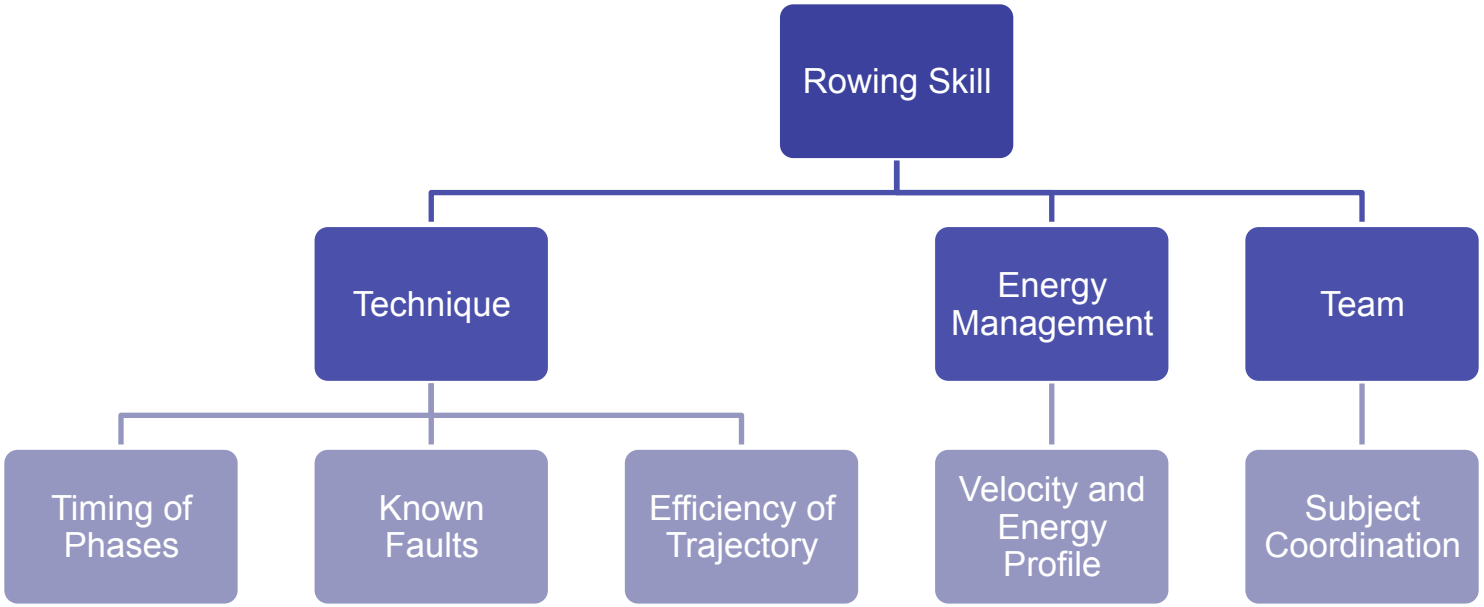
Interaction Principle



SPRINT Experience



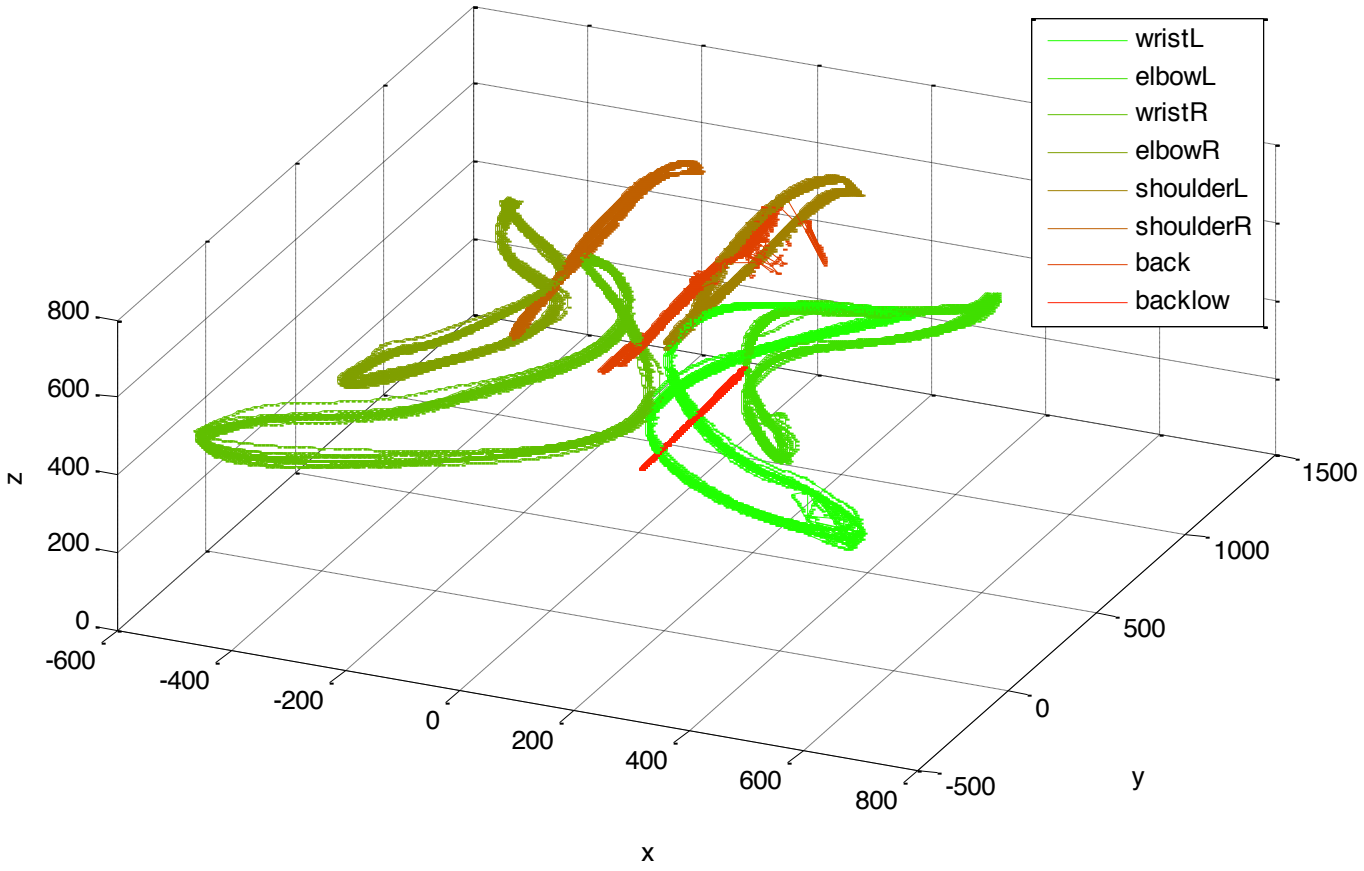
Rowing Skill



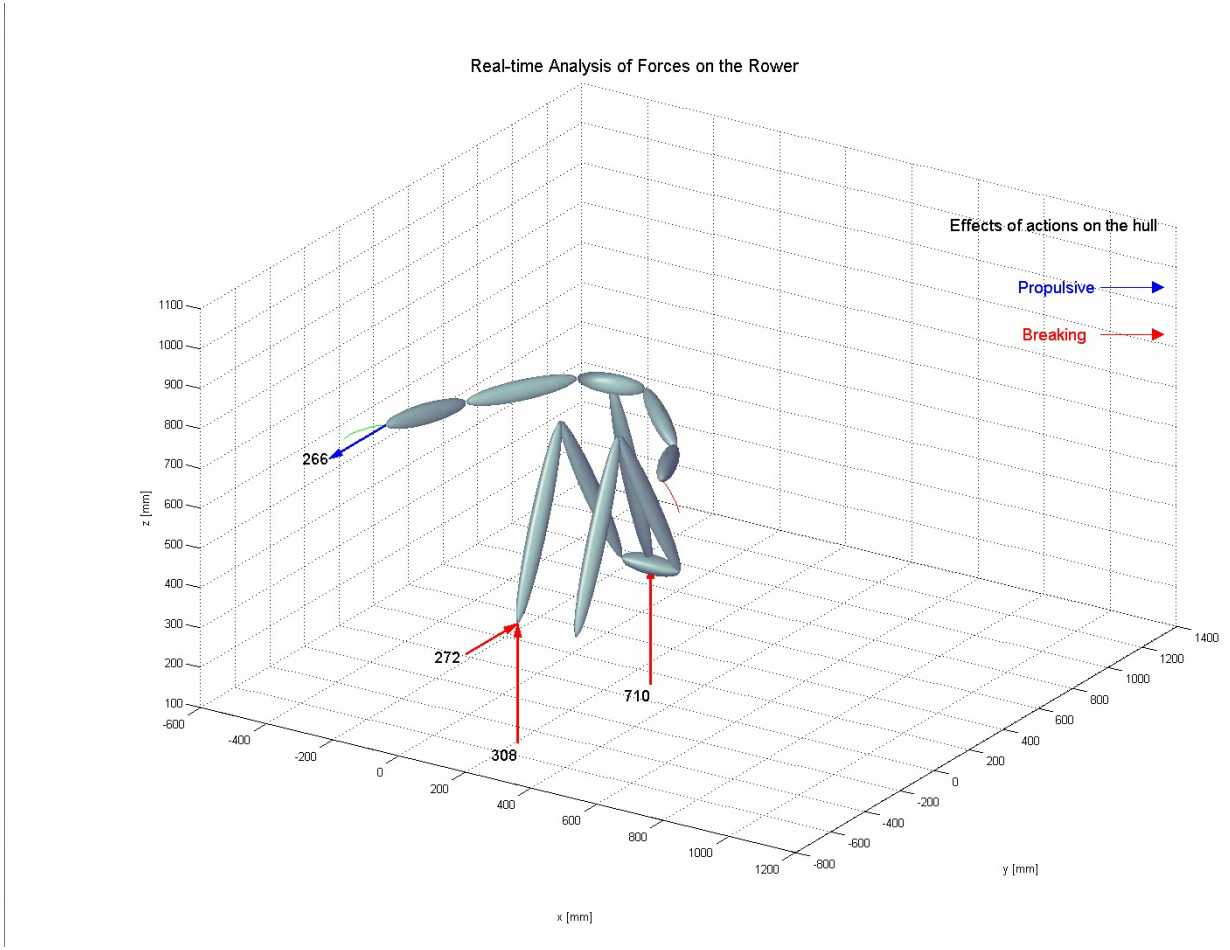
Technique	Energy	Team
•Control flexibility and attention management •Procedural skills •Coping strategies •Bi-manual coordination •Balance and posture control •Perception-by-touch	•Control flexibility and attention management •Coping strategies •Perception-by-touch	•Control flexibility and attention management •Procedural skills •Coping strategies •Balance and posture control •Perception-by-touch

These aspects have been modeled and integrated in real-time capture and analysis in Simulink

Biomechanical Modeling



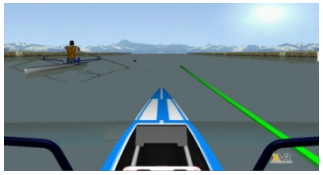
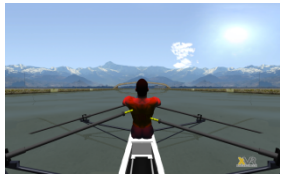
Biomechanical Modeling



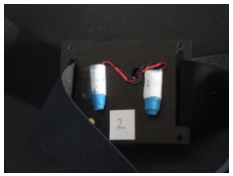
See related poster

Training Accelerators

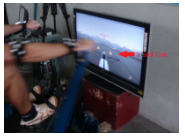
Virtual Human

Localized Vibrotactile

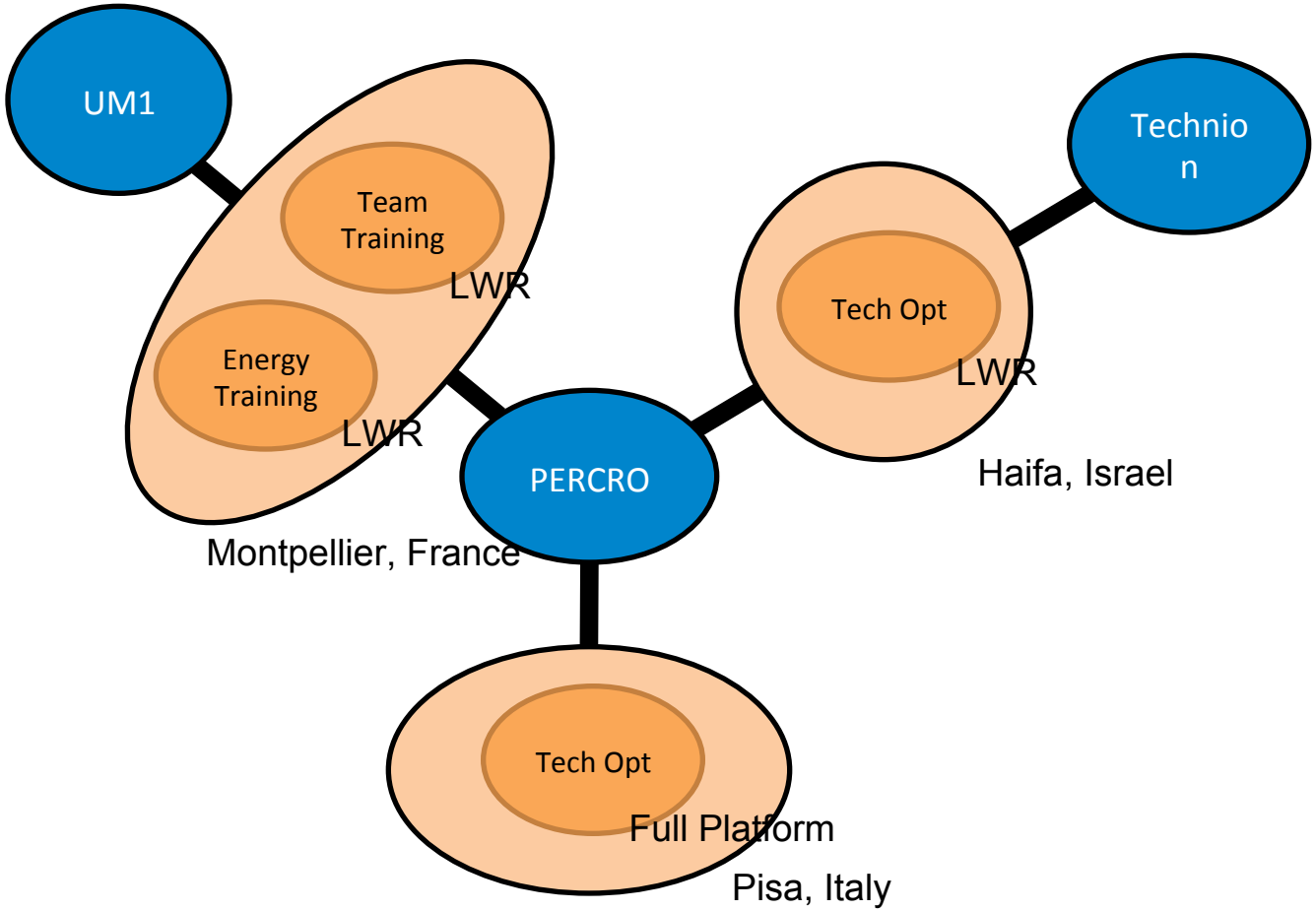


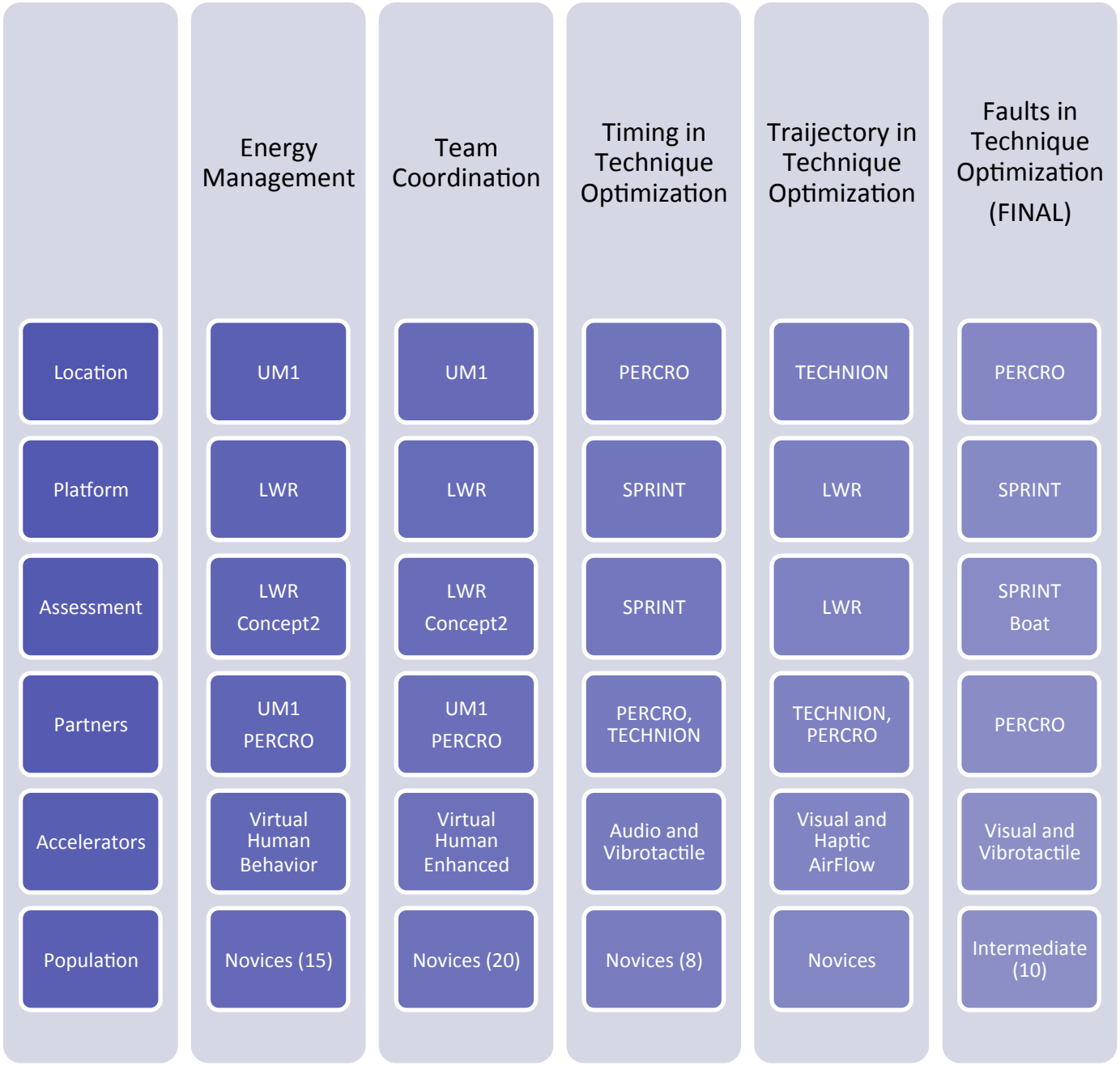

Augmented Visual


See related posters

Evaluations




Energy Management
Team Coordination
Timing in Technique Optimization
Traijectory in Technique Optimization
Faults in Technique Optimization (FINAL)
Location
Platform
Assessment
Partners
Accelerators
Population
UM1
LWR
LWR Concept2
UM1 PERCRO
Virtual Human Behavior
Novices (15)
UM1
LWR
LWR Concept2
UM1 PERCRO
Virtual Human Enhanced
Novices (20)
PERCRO
SPRINT
SPRINT
PERCRO, TECHNION
Audio and Vibrotactile
Novices (8)
TECHNION
LWR
LWR
TECHNION, PERCRO
Visual and Haptic AirFlow
Novices
PERCRO
SPRINT
SPRINT Boat
PERCRO
Visual and Vibrotactile
Intermediate (10)

Transfer

- **Research Question**: how it is possible to correct specific subject errors in intermediate rowers in a short timeframe?
- **Proposed Approach**: leveage previous results on multimodal technique training. Extend them with real-time error recognition

Methodology

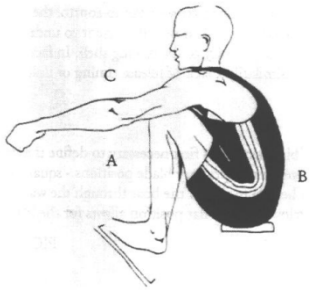
The approach pursued is based on a combination of Expert Data acquisition and Knowledge from Coach and Manuals

1) Manuals provide well known errors
2) Ask experts to perform correct behavior and known errors
3) Process everything using Machine Learning

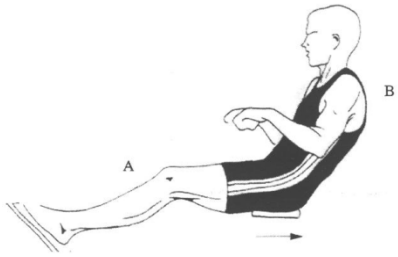
For the purpose of

- Obtaining a way to identify error
- Score Athletes for training

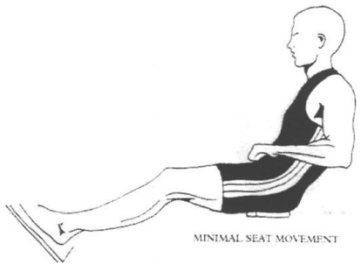
Sculling Phases



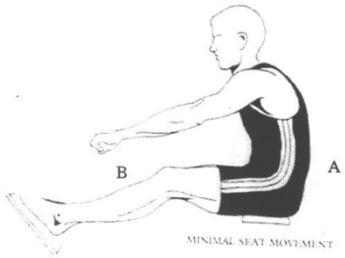
Catch (Blades enter into the water)



Drive (Leg Drive, Back Swing Arm Draw)



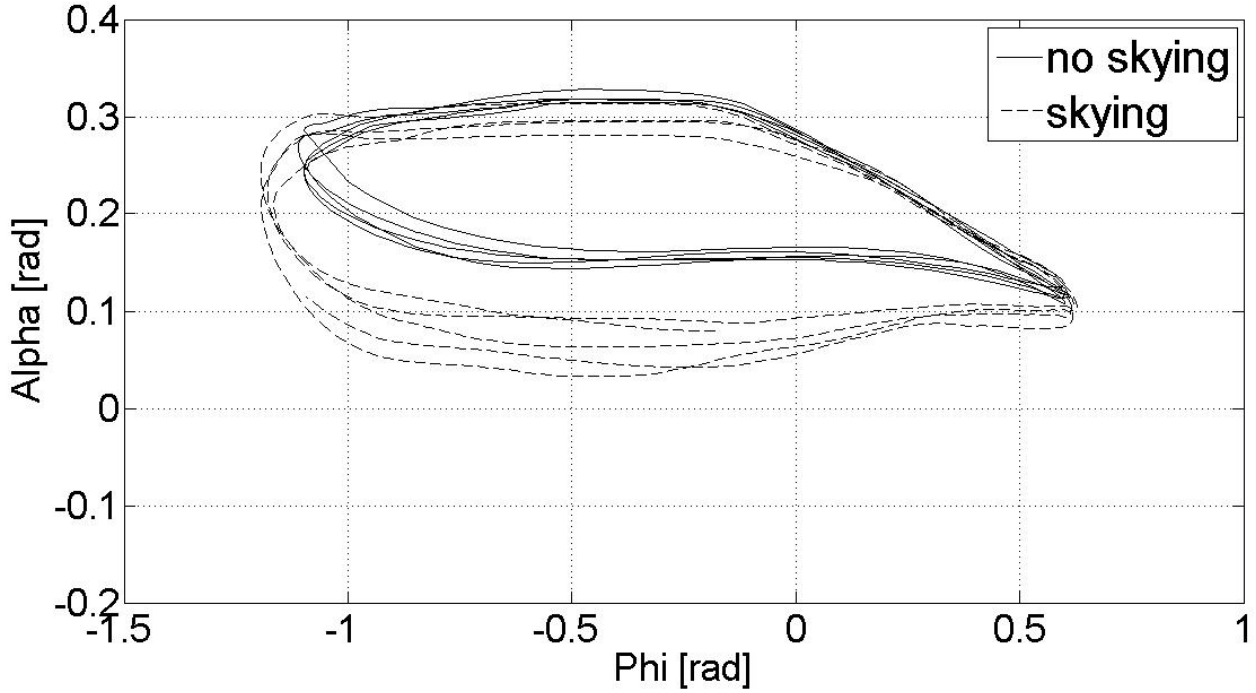
Release (No Propulsion, Blades out of Water)



Recovery

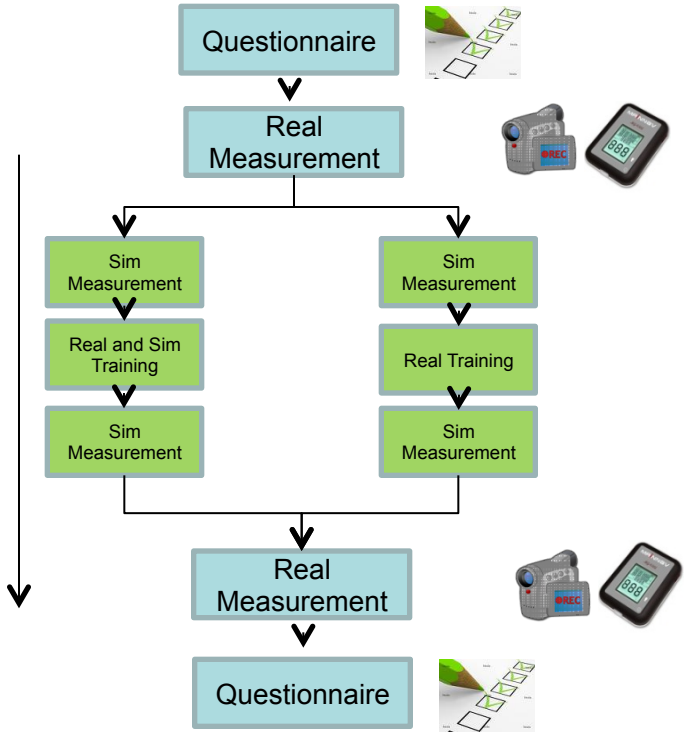
UCLA Manual

Skying Error



Blades Skying	Blades too high off the water at catch.	1. Handles are lowered before being raised. 2. Outside shoulder too low.	1. Row with oars on top of water.

Transfer Design



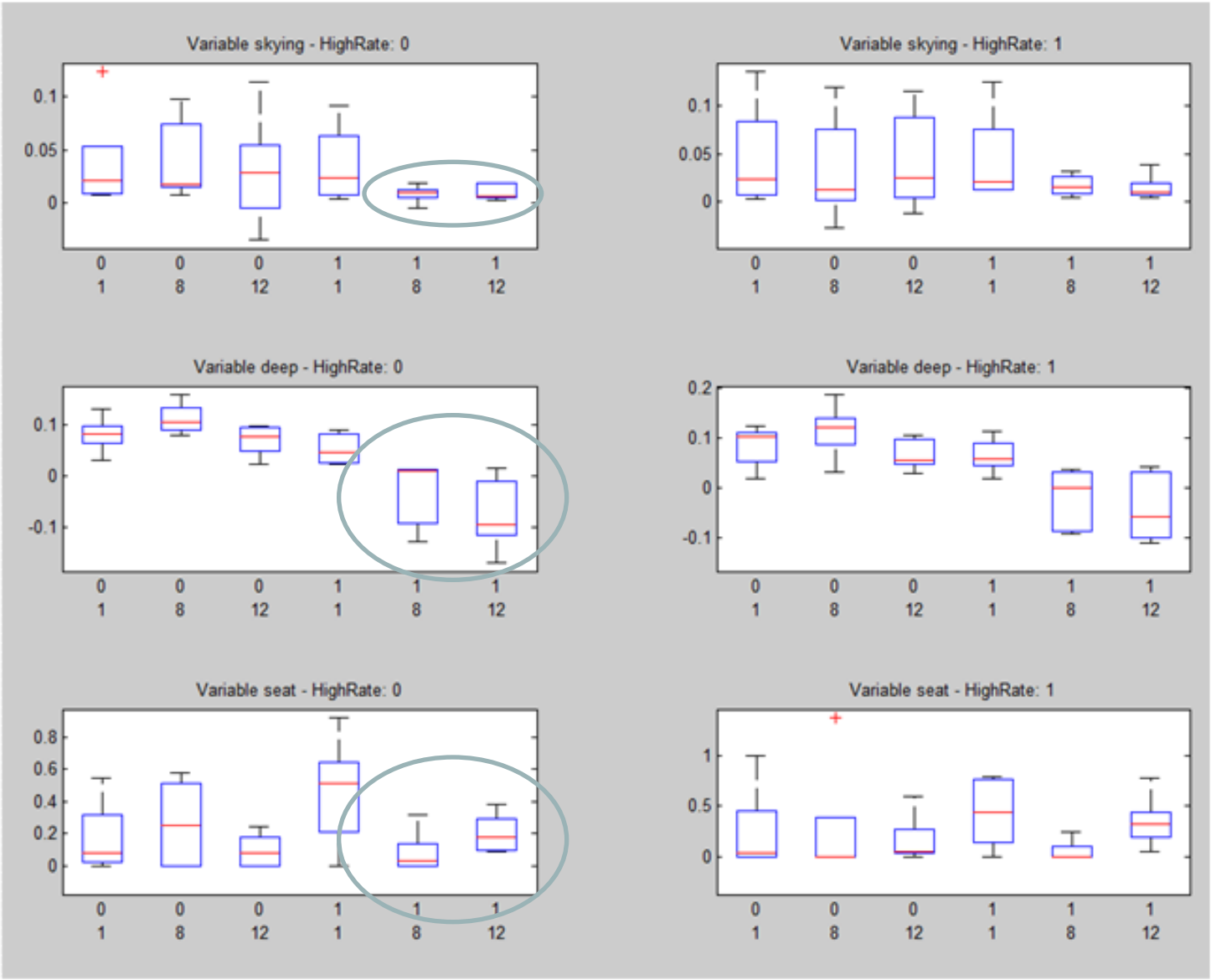
- Record subject on the real boat
- Integrate VE training in real training

Performance and Feedback

- **Performance:** score based on the real-time recognition of errors
- **Feedack:**
  - Visual feedback in the environment

- **Protocol:** 40 days, twice per week
- **Population**: rowers with 5-8 years

Results on SPRINT

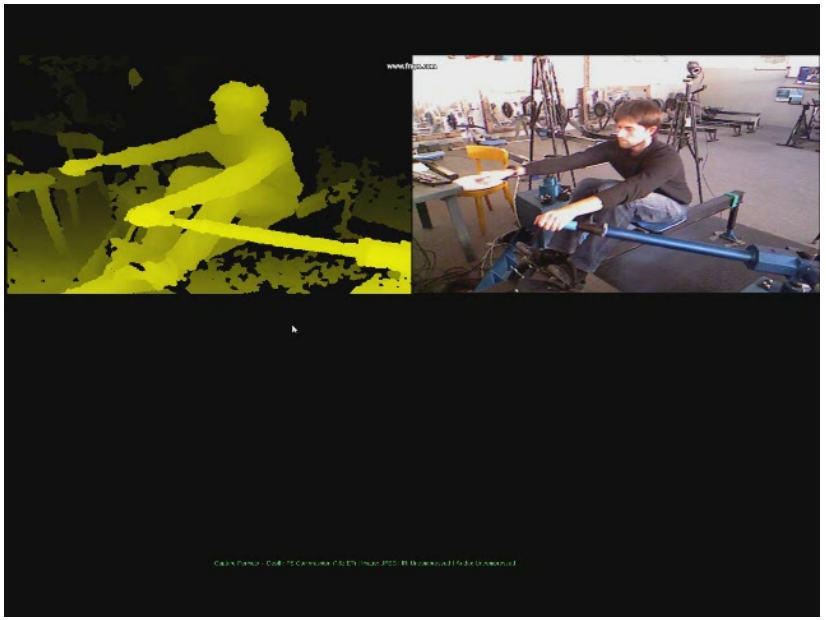


Contributions

- Methodology for training aspects different aspects of rowing in VE
- The SPRINT research platform for investigating complex motor tasks
- Data acquired in the timeframe (40GB)
- Data management

Future Directions

- SPRINT
  - Moving toward active Force feedback
  - Integrate Boat performance in training
  - Generative models of Virtual Rower (DMP like)
  - Moving toward Team boat simulation
  - Better usability for Rowing Clubs
- Sports in VE
  - Role of Robotics
  - Embedded Sensing



You are welcome to see and try the system in our Booth

Acknowledgments

PERCRO Perceptual Robotics Laboratory

Université Montpellier I

AALBORG UNIVERSITY DENMARK

OMG 3D from the moving image

Manuel Varlet Oscar Sandoval Mickaël Ratto Segio Marrucci Benoit Bardy Gaetano Mancini Leonardo Bagnoli Carlo Alberto Avizzano Alessandro Nicoletti Mohamed Machkour Antonio Frisoli Massimo Bergamasco Vittorio Spina Franco Tecchia Sebastien Villard Stas Krupenia Manuel Celentano Pablo Hoffmann Marco Fontana Emanuele Ruffaldi Maria Korman Héctor J. Ché Cortés Sébastien Blanc Charles P. Hoffmann Massimiliano Solazzi Leonard Johard Sébastine Blanc Rosario Leonardi Luc Verbrugge Gregory Ben-sadoun Cristin Cantor-Ferrer Federico Vanni Alessandro Filippeschi Daniel Gopher Elisabetta Sani Paul Smith Yifat Shorr Ludovic Marin

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