

# Non-invasive muscle activity and metabolism monitoring

Prime: Ohmatex A/S, Denmark

Sub: University of Copenhagen, Lonnie Petersen,  
Marco Cardinale, Aspire Academy Sports Science

ESA section (TEC-MMG): Technical Officer, Arnaud Runge

Christian Dalsgaard, CTO

Ohmatex A/S



## PROBLEM STATEMENT - EXERCISE IN SPACE

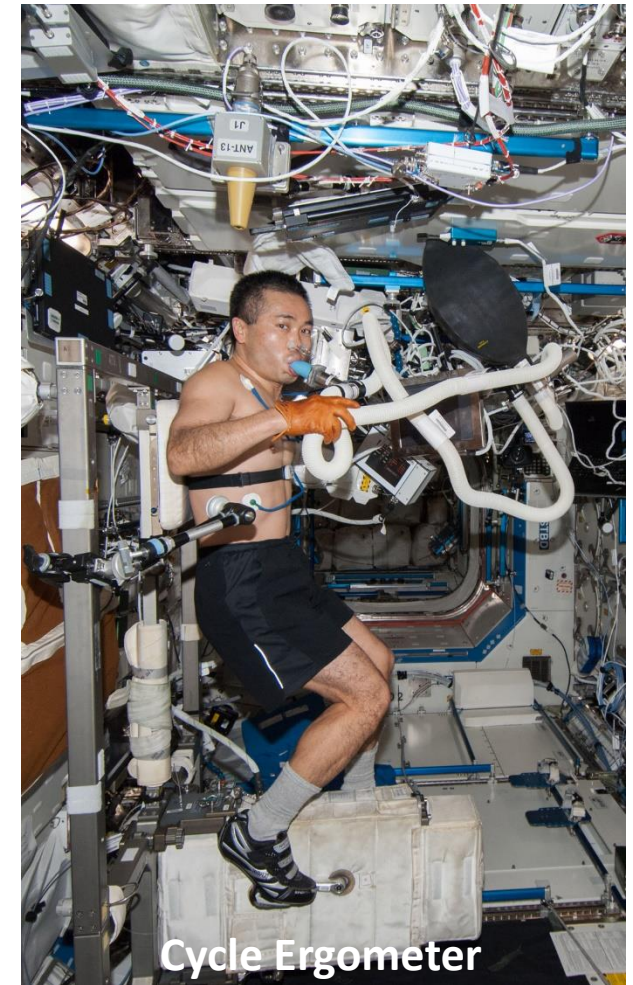
- AEROBIC AND RESISTANCE TRAINING
  - TIME CONSUMING (2 HOURS PER DAY)
  - TRUE EFFECTIVENESS UNKNOWN
- AGENCIES NEEDS TO UNDERSTAND **MUSCLE ATROPHY** AND **BLOOD/FLUID SHIFTS**



Photo: NASA






Treadmill

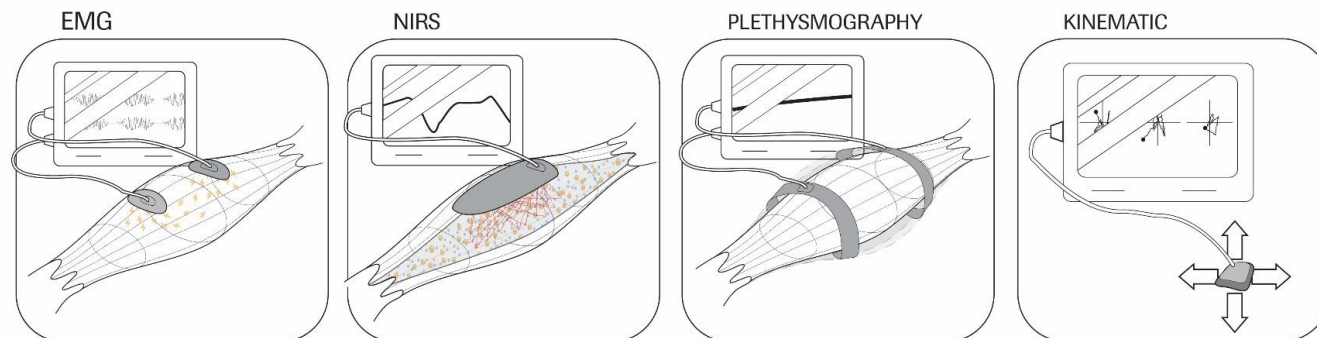


Cycle Ergometer

# SOLUTION – SPORT LEGGINGS WITH SENSORS



-  2 x Combined NIRS and EMG sensors with 3 sensor pads. Accelerometer built into electronics module
-  2 x Plethysmography sensor systems
-  Machine Learning Tools



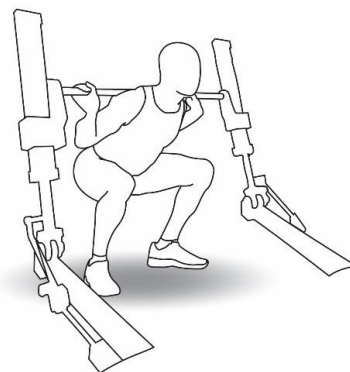
Muscle Activation

Muscle Oxygenation

Change In Leg Volume

Movement

Optimized training during space flight



Insight into muscle activity and metabolism



# ACTIVITY DESCRIPTION – FULL PICTURE

**2009-2012**  
**TRL3<sup>\*)</sup>: Proof of concept**



Technology concept approved

Demonstration of EMG and NIRS

**2014-2018**  
**TRL6<sup>\*\*)</sup>: Demonstration of muscle monitoring system**



EMG, NIRS & Plethysmography combined in full sports leggings.

Validation at University of L'Aquila, Italy and Dept. of Biomedical Science, Copenhagen University

**Next Step....**  
**Flight Demonstration<sup>\*\*\*)</sup>**



Test and validation in space environment

ESA flight qualification of all material, components, electronics and software



Photo: NASA

<sup>\*)</sup> LET-SME 2009 – Leading Edge Technology program, endorsed by the ministerial Council held in The Hague on 25-26 of November 2008, grant k€200.

<sup>\*\*)</sup> GSTP5 sub element 1 supported by the Danish ESA Delegation, grant k€350

<sup>\*\*\*)</sup> National Funding secured May 2017.



## TECHNOLOGICAL ACHIEVEMENTS AND THE VALIDATION

- ALL THREE SENSING TECHNOLOGIES WERE SUCCESSFULLY BUILT AND VALIDATED TO TARGETED TRL'S IN CLINICAL TRIALS.
- RESULTS OF SUB-SYSTEM VALIDATION TESTS ARE PUBLISHED IN PEER REVIEWED JOURNALS.
- **NIRS**<sup>1)</sup> AND **EMG**<sup>2)</sup> TECHNOLOGIES VALIDATED TO **TRL 6** WHERE OPERATIONAL PROCESSORS HAVE BEEN DEVELOPED AND IMPLEMENTED.
- THE **PLETHYSMOGRAPHY SYSTEM**<sup>3)</sup> WAS BUILT FOR **TRL 4** USING BREADBOARD ELECTRONICS AND COTS CAPACITIVE EAP STRETCH SENSORS.
- MEASUREMENT ACCURACY WAS VERIFIED AGAINST CT-SCANS AND SENSITIVITY VERIFIED THROUGH FUNCTIONAL TESTS. A ROADMAP IS ESTABLISHED FOR FURTHER DEVELOPMENT.

*1) NIRS: Near Infrared Spectroscopy - oxygenation in and around muscle,*

*2) EMG: Electromyography – muscle activation, 3) Plethysmograph: Leg volume to detect fluidshift*





Ohmatex spin-off

## MUSCLE PERFORMANCE MONITORING

Provides intelligent insight in both the **cardiovascular and muscular system** simultaneously and in real-time.

*Today, no other solution is available in the market integrating NIRS, EMG and accelerometer.*



Ohmatex spin-off

## EDEMA – LEG VOLUME MONITORING SYSTEM

Monitors accumulation of excess fluid in the lower leg for cardio-vascular patients.

*U.S. News & World Report December 9, 2015: "Among the 7 Tech Advances that will change seniors' lives in US"*







## OUR VISION AND MISSION STATEMENT

Provide **world class** market ready solutions and products to principal customers

Continuously innovate in the **cross field of electronics and textiles**



# THE TEAM



**Klaus Østergaard**  
CEO, Business Wizard



**Christian Dalsgaard**  
CTO & Founder  
Smart Textile Pioneer



**Henrik Søgaard**  
R&D Manager  
Biomedical Engineer



**Carl Kristian Sørensen**  
Project Manager  
Textile Engineer



**Kåre Sørensen**  
Development Engineer  
Electrical Engineer



**Anders Klitgaard**  
Industrial Designer  
Mechanical Engineer



**Ibrahim Al-Tal**  
Project Manager  
Electrical Engineer



**Helene Vistisen**  
Concept Developer  
Biomedical Engineer



**Rune Heick**  
Software Developer  
Computer Engineer



**Karl-Johan Schmidt**  
Project Specialist  
Biomedical Engineer



**Anne Jensen**  
Project Coordinator  
ESA Expert



**Sanne Lindhardt**  
Marketing Coordinator  
Communication & Co

Company funded by commercial development  
and private investments into scalable products.

# THANK YOU TO ESA AND PARTNERS

