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OHMATEx A/S

TEXTILE INTEGRATED WEARABLES IN SPACE AND ON EARTH
E-TEXTILE 2019, 12TH NOVEMBER 2019

This soft display-label indicates critical heat levels **before** they result in physical injury to the fire fighter

OHMATEX HERITAGE:
WORLDS FIRST FIREFIGHTER SUIT WITH
INTEGRATED HEAT STRESS ALERT.

In 2007 global PPE leader Viking Life-Saving Equipment A/S teamed up with Ohmatex to create a fully functioning prototype designed and manufactured with smart textile technologies.



*Winner of the Engineering Society's 2007
Danish Product Award*





OUR VISION AND MISSION STATEMENT

Provide world class **market ready** smart textiles

Continuously innovate in the **intersection between electronics & textiles**

PIONEERING E-TEXTILES



Conductive Yarns



Textile Wiring & Circuitry

Electronics Development



Confectioning



Textile Sensors



Electronics Encapsulation

Mounting & Integration



Wearable Applications



Textile integration that works



ALL THESE TECHNIQUES HAVE BEEN DEMONSTRATED TO WORK FOR UP TO **150 WASH CYCLES**.



MOULDING SNAP
CONNECTORS TO TEXTILES



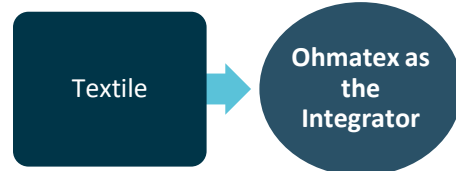
LAMINATING AND
INTERCONNECT FABRIC
SENSORS



WEAVING IN CONDUCTORS



ENCAPSULATION OF
ELECTRONICS AND SENSORS



EXERCISE IN SPACE

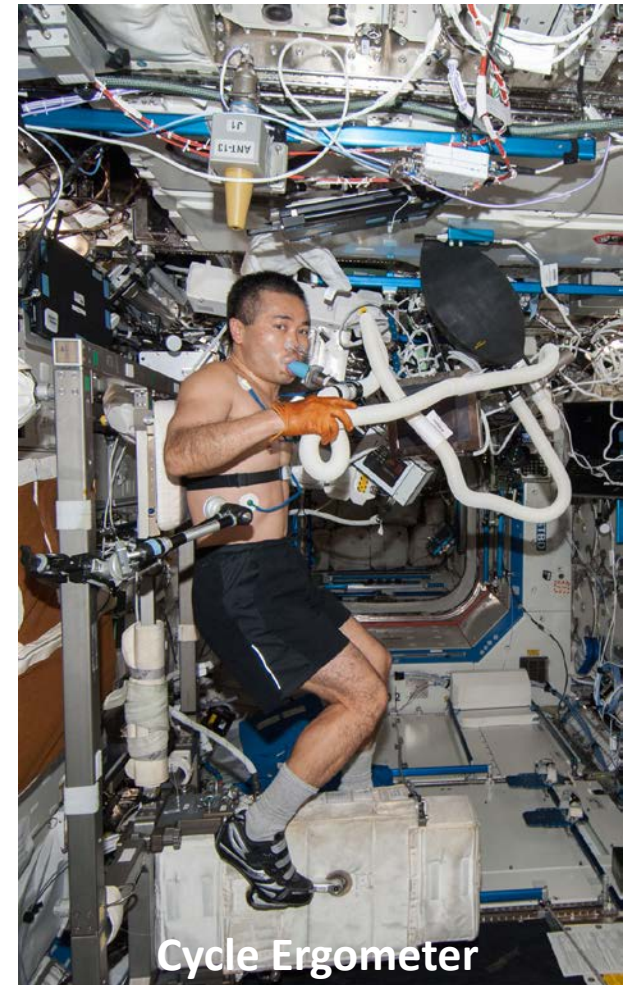
- AEROBIC AND RESISTANCE TRAINING
 - TIME CONSUMING (2 HOURS PER DAY)
 - TRUE EFFECTIVENESS UNKNOWN
- AGENCIES NEEDS TO UNDERSTAND **MUSCLE ATROPHY** AND **BLOOD/FLUID SHIFTS**



Photo: NASA



Treadmill



Cycle Ergometer

SPACE DEVELOPMENT – FULL PICTURE

2009-2012

TRL3^{*)}: Proof of concept



Technology concept approved

Demonstration of EMG and NIRS

2014-2018

TRL6^{)}: 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^{*)}**



Test and validation in space environment

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



Photo: NASA

^{*)} 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.

^{**)} GSTP5 sub element 1 supported by the Danish ESA Delegation, grant k€350 (ESA-2)

^{***)} National Funding secured May 2017 (ESA-3)



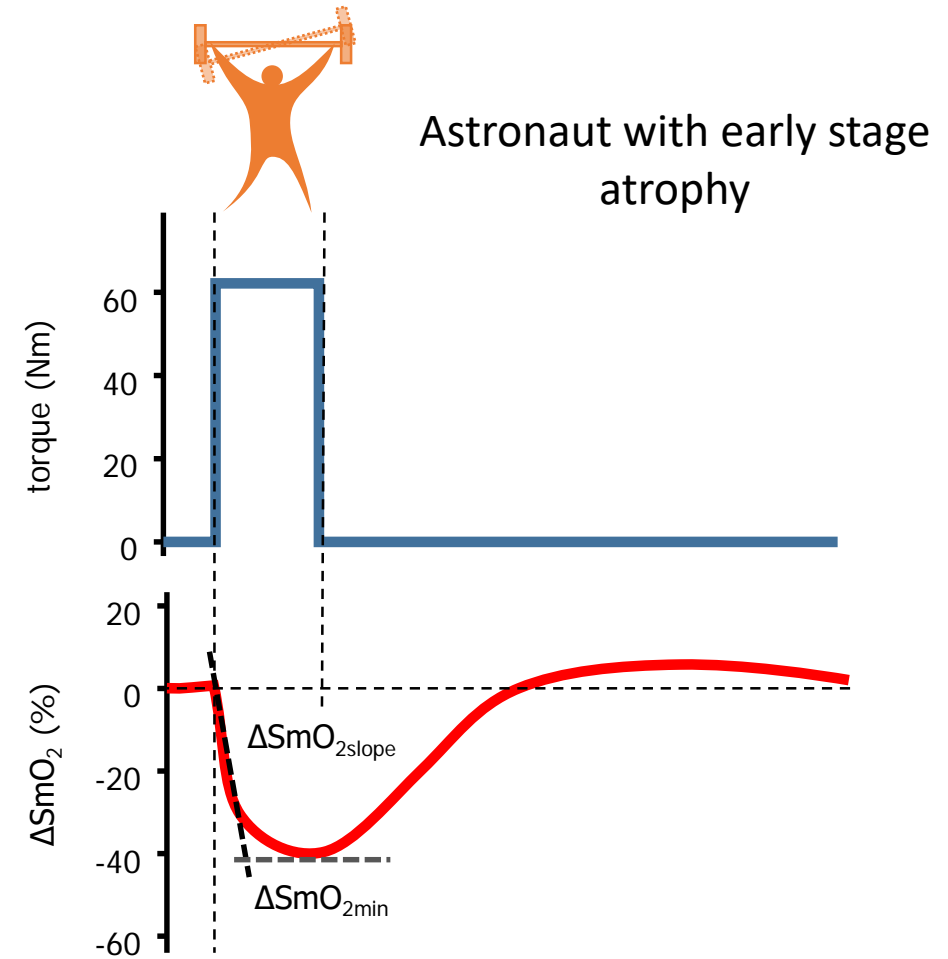
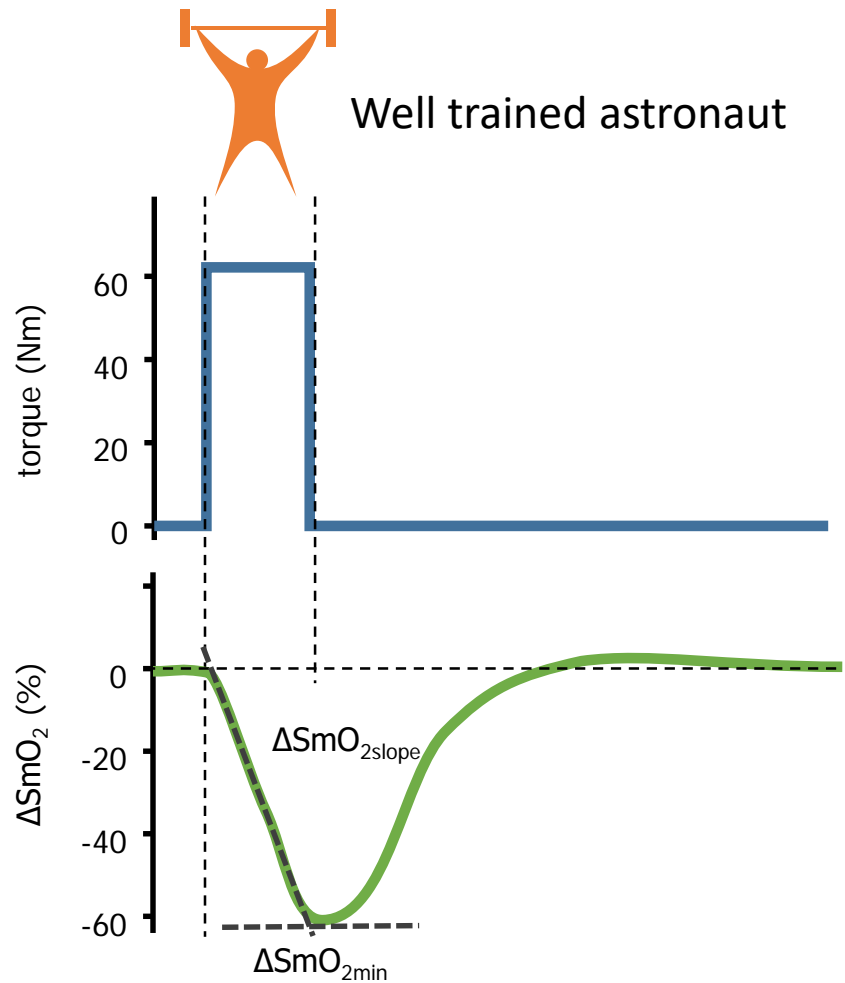
ISS DEMONSTRATION FLIGHT

- VERIFY ABILITY TO MEASURE CHANGES IN LIMB CIRCUMFERENCE AND VOLUME, TISSUE OXYGENATION AND MUSCLE ACTIVATION PATTERNS DURING TRAINING ON EARTH AND IN MICROGRAVITY.
(TECHNICAL PURPOSE)
- COMPARE MEASUREMENTS IN MICROGRAVITY WITH THOSE OBTAINED IN TERRESTRIAL ENVIRONMENTS. INVESTIGATE IF FLUID SHIFT AND CHANGES IN STARLING FORCES*) INFLUENCE THE PERFORMANCE OF MUSCLE WORK AND LEAD TO ALTERED FUNCTION AND EARLIER MUSCLE FATIGUE.
(SCIENTIFIC PURPOSE)
- IT IS NECESSARY TO FLY THE TECHNOLOGY ON THE ISS TO VERIFY THIS, AS IT IS NOT POSSIBLE TO SIMULATE CHANGES IN STARLING FORCES ON THE GROUND.
- PARTNERSHIP: OHMATEX, UNIVERSITY OF COPENHAGEN, DANISH AEROSPACE COMPANY.

*) Starling Forces control the passive exchange of water between the capillary microcirculation and the interstitial fluid.



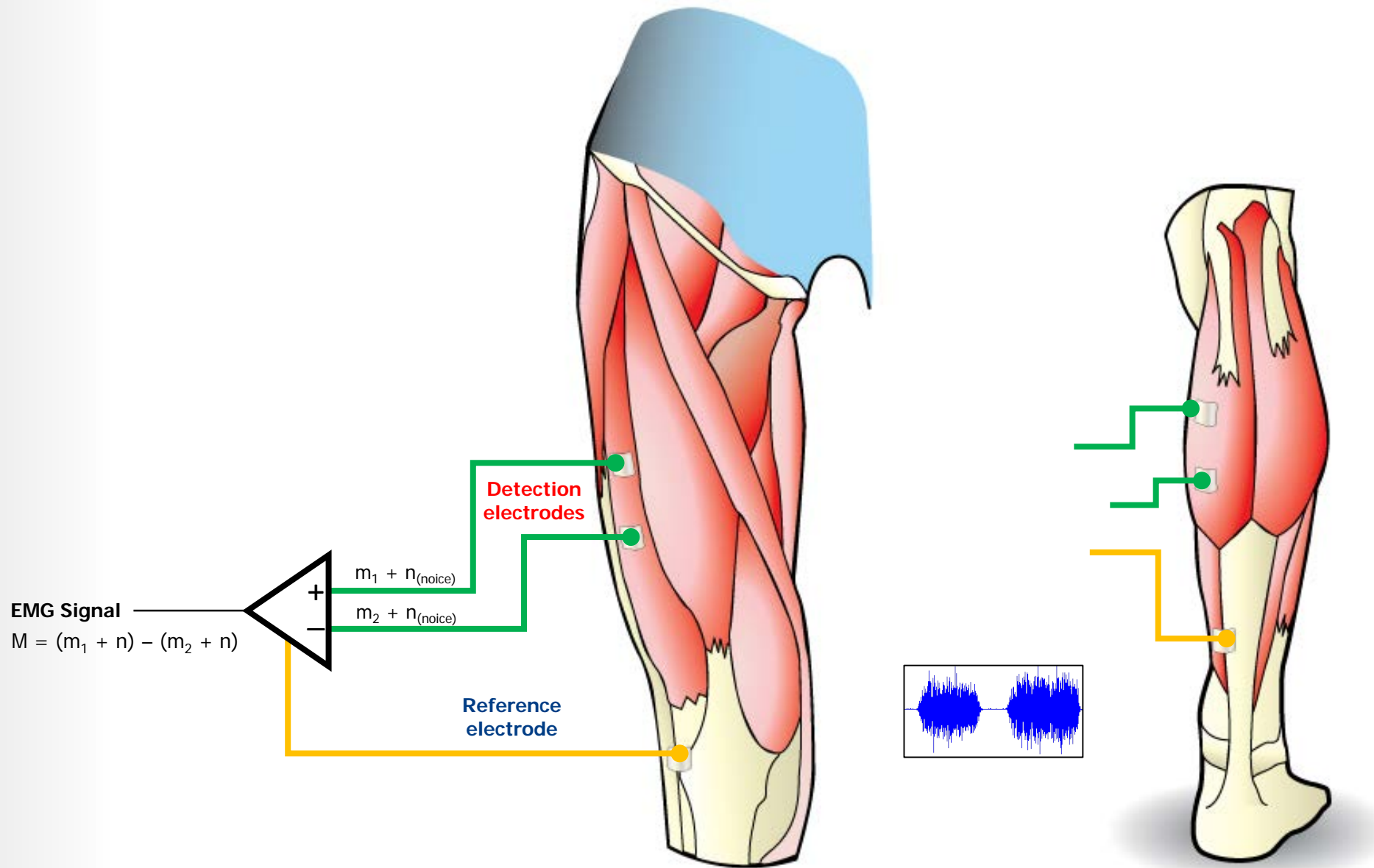
NEAR-INFRARED SPECTROSCOPY



OBSERVATION OF TISSUE OXYGENATION PARAMETERS ($\Delta\text{SmO}_{2\text{slope}}$ AND $\Delta\text{SmO}_{2\text{min}}$) CAN IDENTIFY EARLY STAGE **MUSCLE ATROPHY**. NIRS IS THE ONLY NON-INVASIVE TECHNOLOGY WHICH CURRENTLY ENABLES THIS.



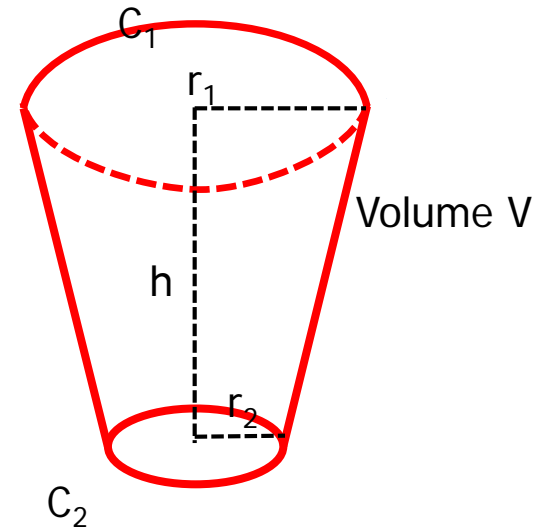
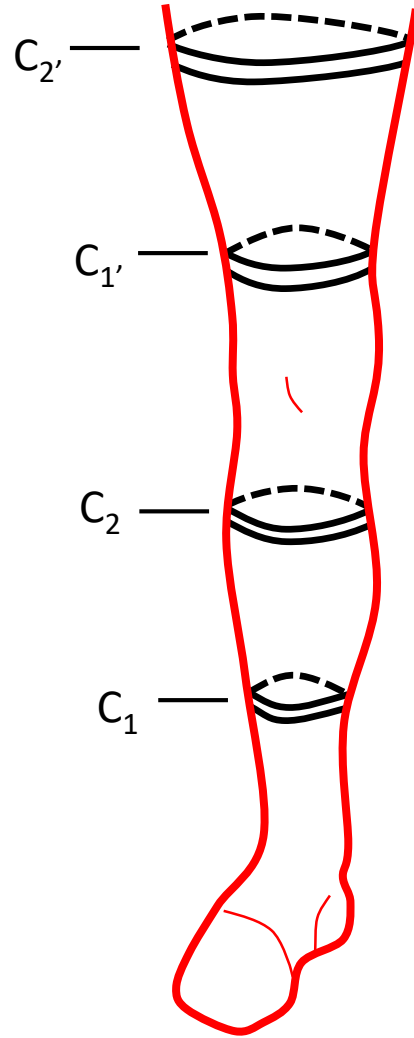
EMG



THE EMG SIGNAL DETECTS THE **ACTIVATION LEVELS** OF THE MUSCLE AND NORMALLY USED AS AN INDICATOR OF MUSCLE WORK AND FATIGUE.



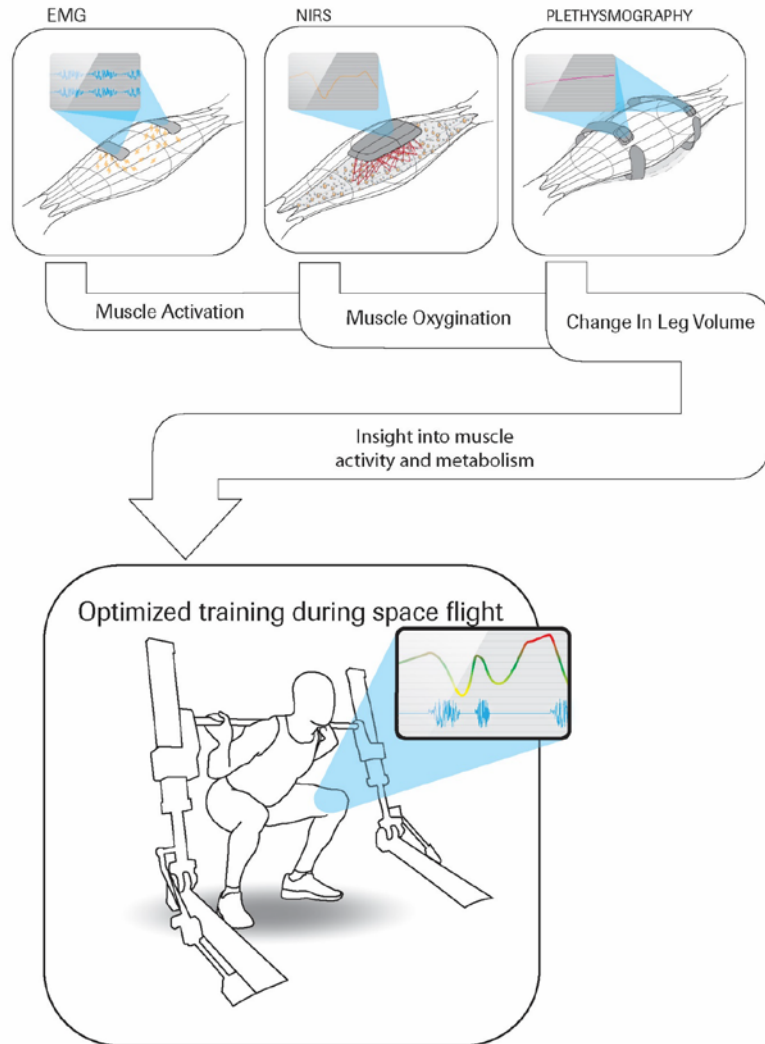
PLETHYSMOGRAPHY



$$V_{leg} = \sum_{leg} V_n$$

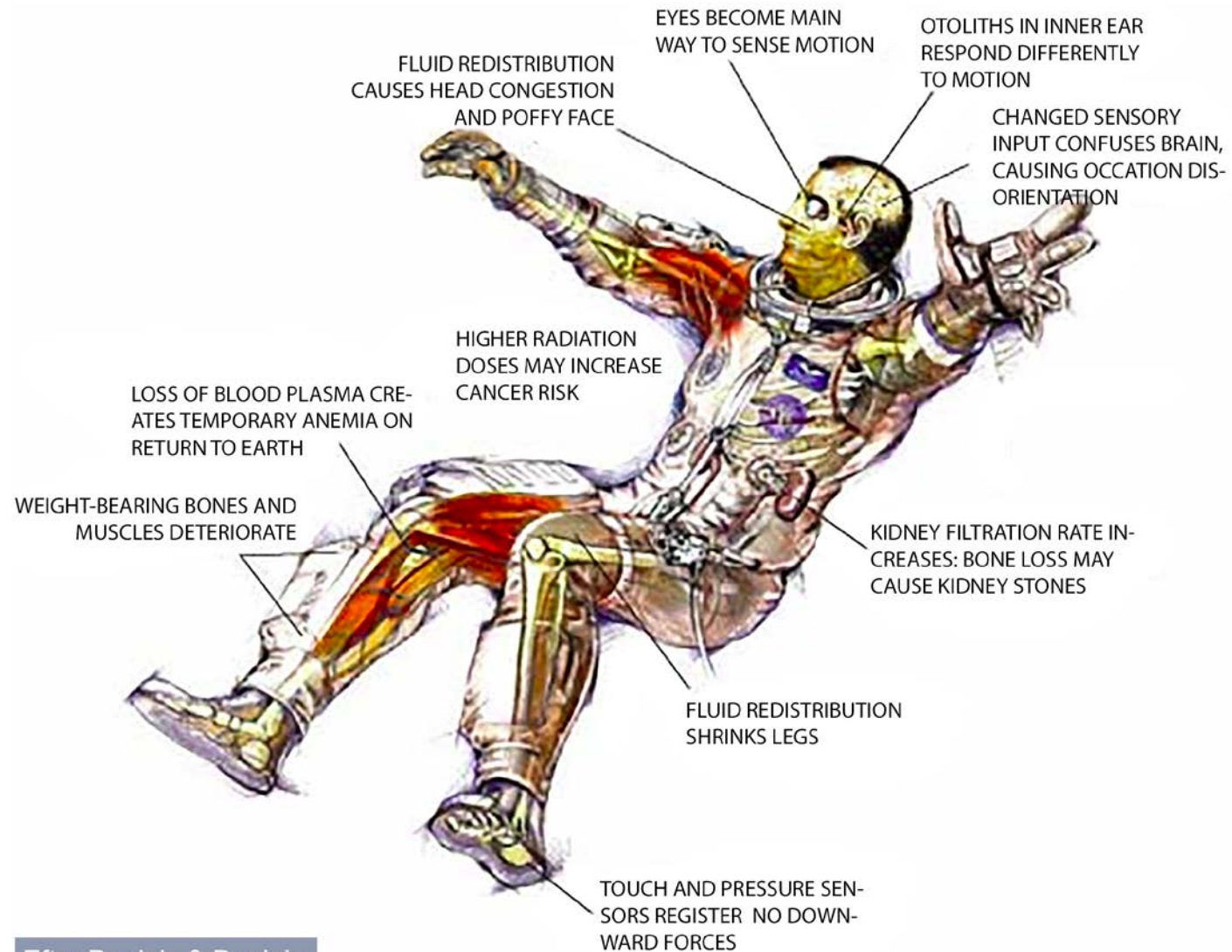
MEASUREMENT OF LEG VOLUME (PLETHYSMOGRAPHY) IS A TOOL FOR MONITORING THE DISPLACEMENT OF LIQUID (**FLUID SHIFT**).

GAIN – GARMENTS FOR ADVANCED INSIGHTS

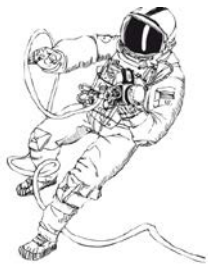


GainTights YouTube [video](#)

EFFECTS OF SPACE FLIGHTS ON HUMAN BODY:



Efter Daniels & Daniels



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.

EXAMPLES OF DISSEMINATION

- DANSK INDUSTRI, SEPT. 2015
- NATURVIDENSKABERNES HUS, OCT. 2015
- ESA FINAL PRESENTATION DAY, NOV. 2018
- DANMARKS TEKNISKE MUSEUM, MAY – SEP 2018
- AARHUS STATSGYMNASIUM, MARCH 2019
- ...





For Palarum, LLC

PATIENT FALL PREVENTION SYSTEM

Palarum's PUP™ smart socks are the most advanced patient mobility monitoring system in healthcare ([video](#))



For PreCure IVS

WEARABLE EMG SLEEVE

Preventing one of the biggest work injury problems in the world – mouse arm



Animated [cartoon](#) from dropbox:



For Manus VR

BRINGING TRUE INTERACTION TO VIRTUAL REALITY

Smart textile development grows out of unexpected fields

THANK YOU

