



Defence Materiel Organisation
Ministry of Defence

Physical Loads FRISC Steps taken forward

HSBO 2016

DMO

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Overview

- Introduction
- Working group physical loads FRISC
- Short term solution
- Measuring campaign



Fast Raiding Interception Special forces Craft FRISC





Operational context

- FRISC characteristics -> New operational concepts
- a vital link between mothership/base and operational target
- FRISC is a 'weapon system'
- a 'game changer'
- ..has huge operational potentials,
- but...human is the limiting factor !





Working group physical loads FRISC

- Multidisciplinary team on issues on physical loads FRISC
- Operational specialists
- Medical specialist
- Technical specialists

- Motions
- Noise
- Equipment



Short term solutions

- Sail and recovery table
 - Developed by the working group
 - Based on experience
 - Vessel type
 - Sea state
 - Used in practice
- Specific sports training



Measuring campaign

- Personnel
 - Logging activities
 - Dosimetry
 - Health monitoring program
- Seats
 - Drop tests
 - Madymo analysis



Logging activities

- No Sortie
- Pre-Sortie
- Post-Sortie
- Every week



Logging activities

- Date and time
- Sailing time
- Equipment
- Pain
 - Physical
 - Mental
- Tiredness
- Sleep
- Other activities
- Alcohol and medication

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The figure shows two human silhouettes, one facing forward and one facing backward. Each silhouette has 22 numbered points indicating areas for pain assessment. The front view points are: 1 (forehead), 2 (right eye), 3 (bridge of nose), 4 (left eye), 5 (forehead), 6 (right shoulder), 7 (left shoulder), 8 (right elbow), 9 (left elbow), 10 (right wrist), 11 (left wrist), 12 (right chest), 13 (left chest), 14 (right abdomen), 15 (left abdomen), 16 (navel), 17 (right hip), 18 (left hip), 19 (right knee), 20 (left knee), 21 (right ankle), 22 (left ankle). The back view points are: 23 (right eye), 24 (left eye), 25 (bridge of nose), 26 (right shoulder), 27 (left shoulder), 28 (right elbow), 29 (left elbow), 30 (right wrist), 31 (left wrist), 32 (right chest), 33 (left chest), 34 (right abdomen), 35 (left abdomen), 36 (navel), 37 (right hip), 38 (left hip), 39 (right knee), 40 (left knee), 41 (right ankle), 42 (left ankle), 43 (right heel), 44 (left heel), 45 (between feet).



Dosimetry

- Phase 1 – Pilot
- Phase 2 – Validation
- Phase 3 – Data acquisition
- Phase 4 - Implementation



$\pm 3 \times 5 \times 1,5$ cm

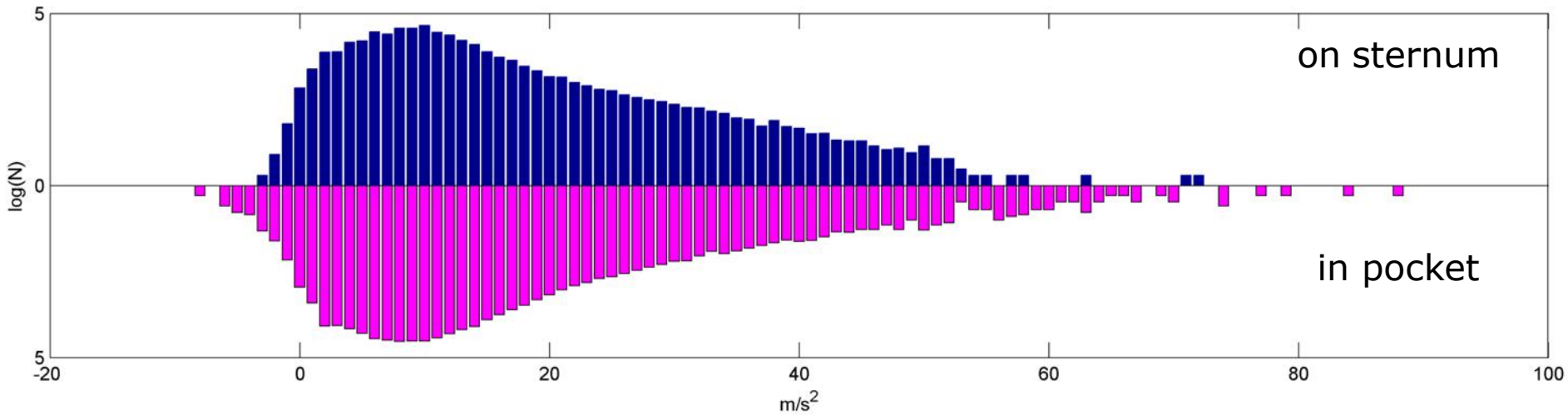
Note:
dose = amplitude,
duration, heading and
posture orientation

- 3 accelerometers ± 2 g
- 3 accelerometers ± 16 g
- 3 rotationsensors (gyro's)
- 3 magnetometers
- intern data-logging
- bluetooth
- application with ECG / EMG
- adjustable



Results

- # samples per observed acceleration interval





Health monitoring program

- Non invasive
- Yearly

- Questionnaire
- Biometry
- Urine analysis
- Audiogram
- Physical examination

- Additional medical examination/treatment on indication



Seats

- Determine design pulse
 - Impact measurements Curacao & NL
 - Relevant literature
- Drop tests
 - Seat with deadweight
- Calculations with Madymo





Curaçao measuring



Video drop tests





MAThematical DYnamic MOdels (MADYMO)

Controlled **head** position using **neck** muscles (van der Horst 2002, Meijer et al. 2012, 2013) + balanced muscle recruitment (based on Nemirovsky & van Rooij 2010)

Multi-body occupant model (based on Happee et al. 1998, 1999, 2000, Meijer et al. 2008)

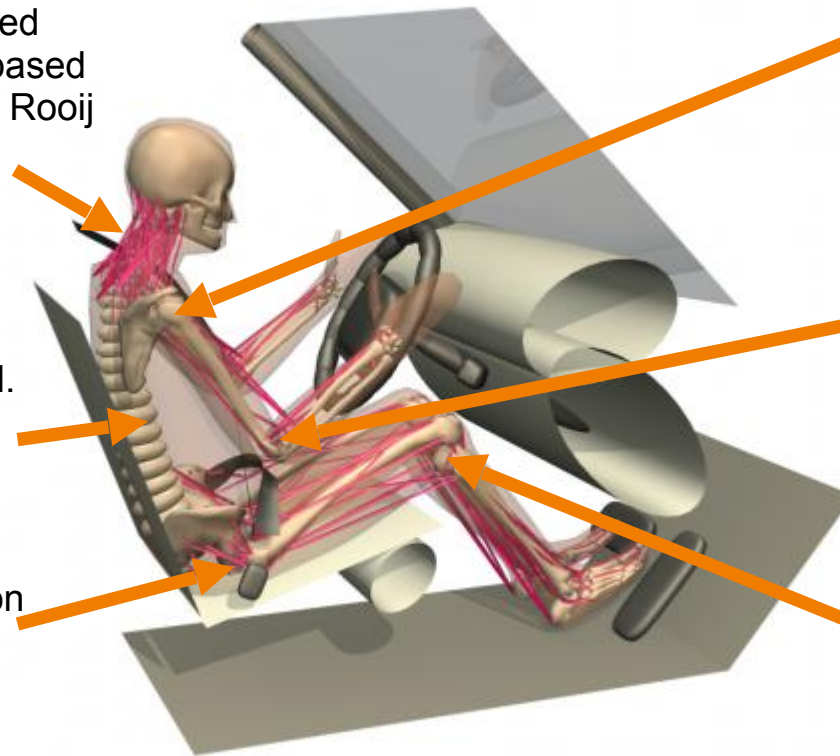
Controlled **shoulder** positions using actuators (Meijer et al. 2013)

Controlled **spine** position using actuators (Meijer et al. 2012, based on Cappon et al. 2007)

Detailed **arms** (Meijer et al. 2008) + controlled elbow position using arm muscles (Meijer et al. 2013)

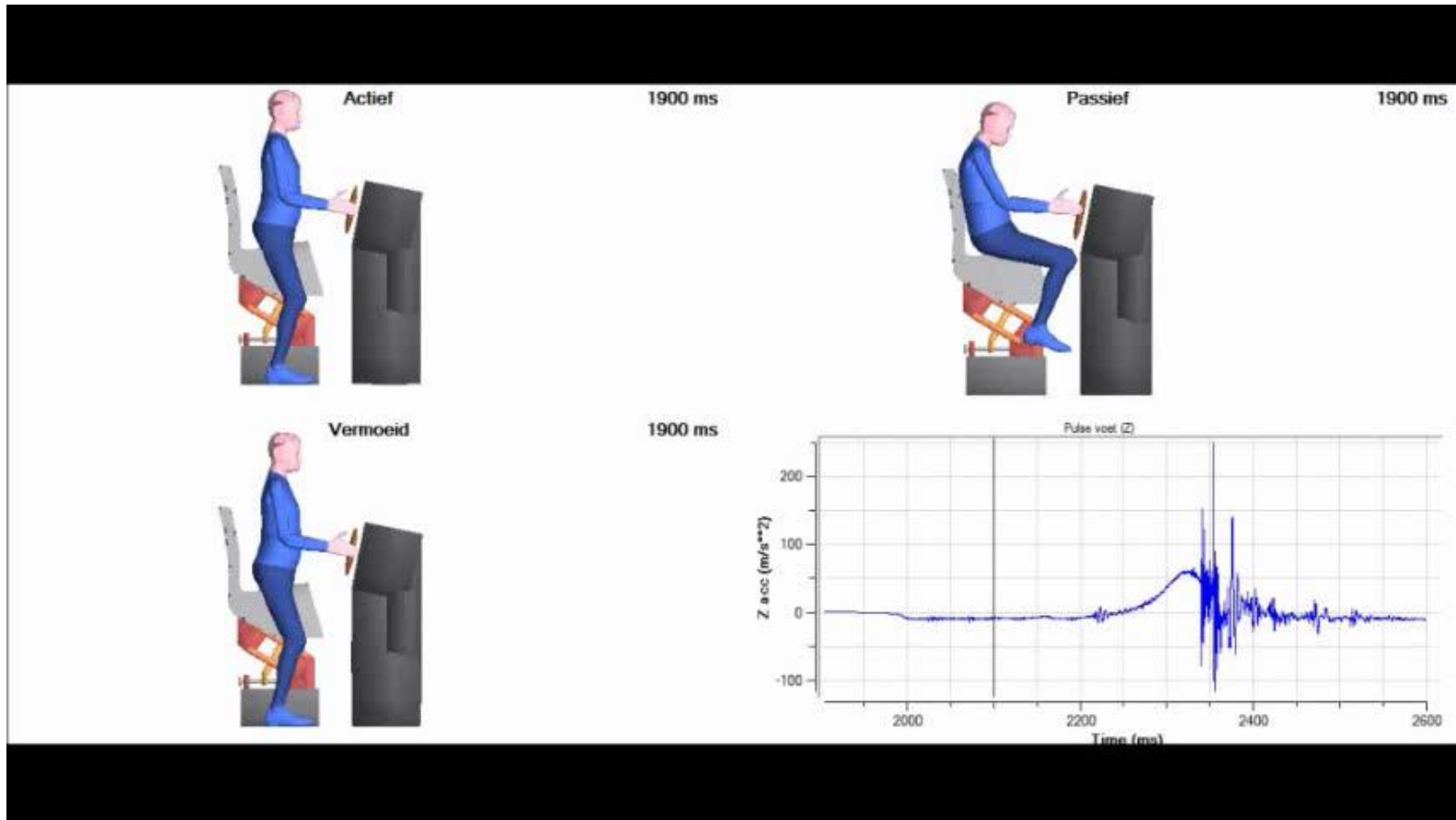
Controlled **hip** position using leg muscles (Meijer et al. 2012)

Detailed **legs** (Cappon et al. 1999) + controlled knee position using leg muscles (in development)





Video Madymo





Simulator - FSSS

- Motion based simulator
- Protection of trainers
- Train independent of the weather
- Less wear and tear FRISC's
- Lower fuel consumption







Conclusions

- Short term solutions
- Health monitoring program
- Measuring campaign
- Modelling and simulation
- Long term effects

Thank you for your attention

Questions?

