Monitoring mental and physical condition of space crew

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Affiliation: TACR ETA program to support applied social science, experimental development and innovation

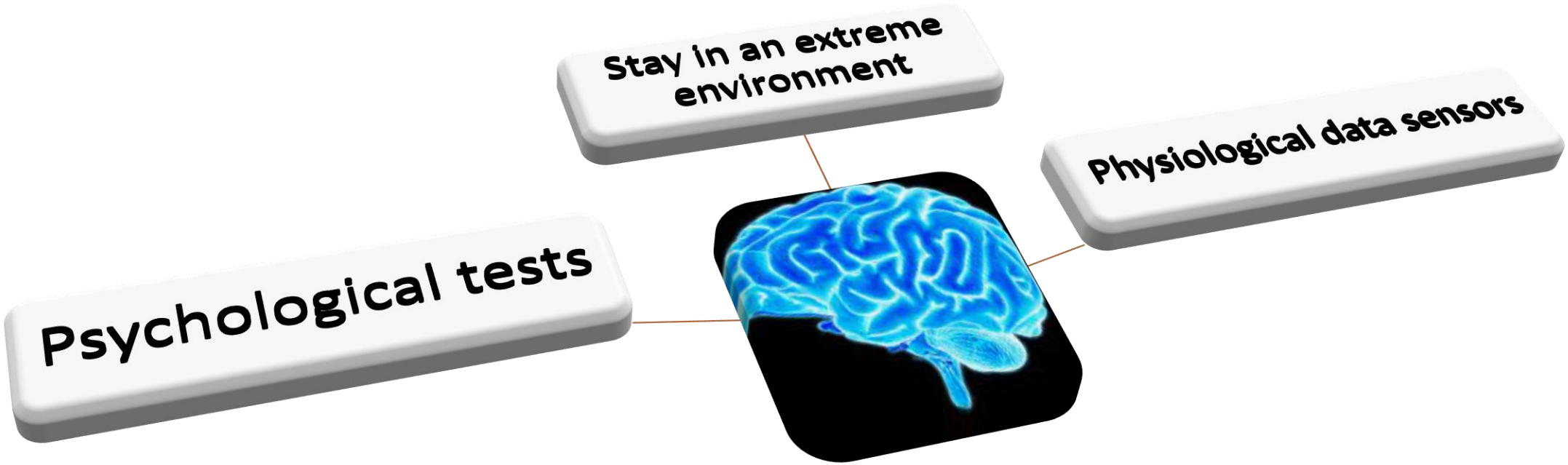
Project: TL05000228

Name of project: Tool for assessment of personal characteristics and external factors to improve efficiency and collaboration of the team during a long-time stay in ICE environment

ICE
(Isolated, Confined, and Extreme) environment

- **Natural vs. artificial** ICE environment
- **Analog missions**
- **Preselection and screening of individuals and team members**

Analog missions in ICE environment



R&D

- Several research projects in the world
- Often used **Antarctica, underwater laboratories,…**
- Various studies on cognitive functions:

- attention **concentration**,
- **thinking ability**,
- change in psychomotor **performance**, ….

- Studies focused on the influence of **seasonal changes in the environment, cold, isolation, sensory deprivation**
- Long-term studies have shown effects on an **individual's emotional experience**

Direction of R&D

- Finding the psychophysiological context of the **influence of the environment on individuals**
- Monitoring the influence of a **social group**
- Impacts on **social isolation**
- Impacts on **emotional experience**

Tool for assessment of personal characteristics and external factors to improve efficiency and collaboration of the team during a long-time stay in ICE environment

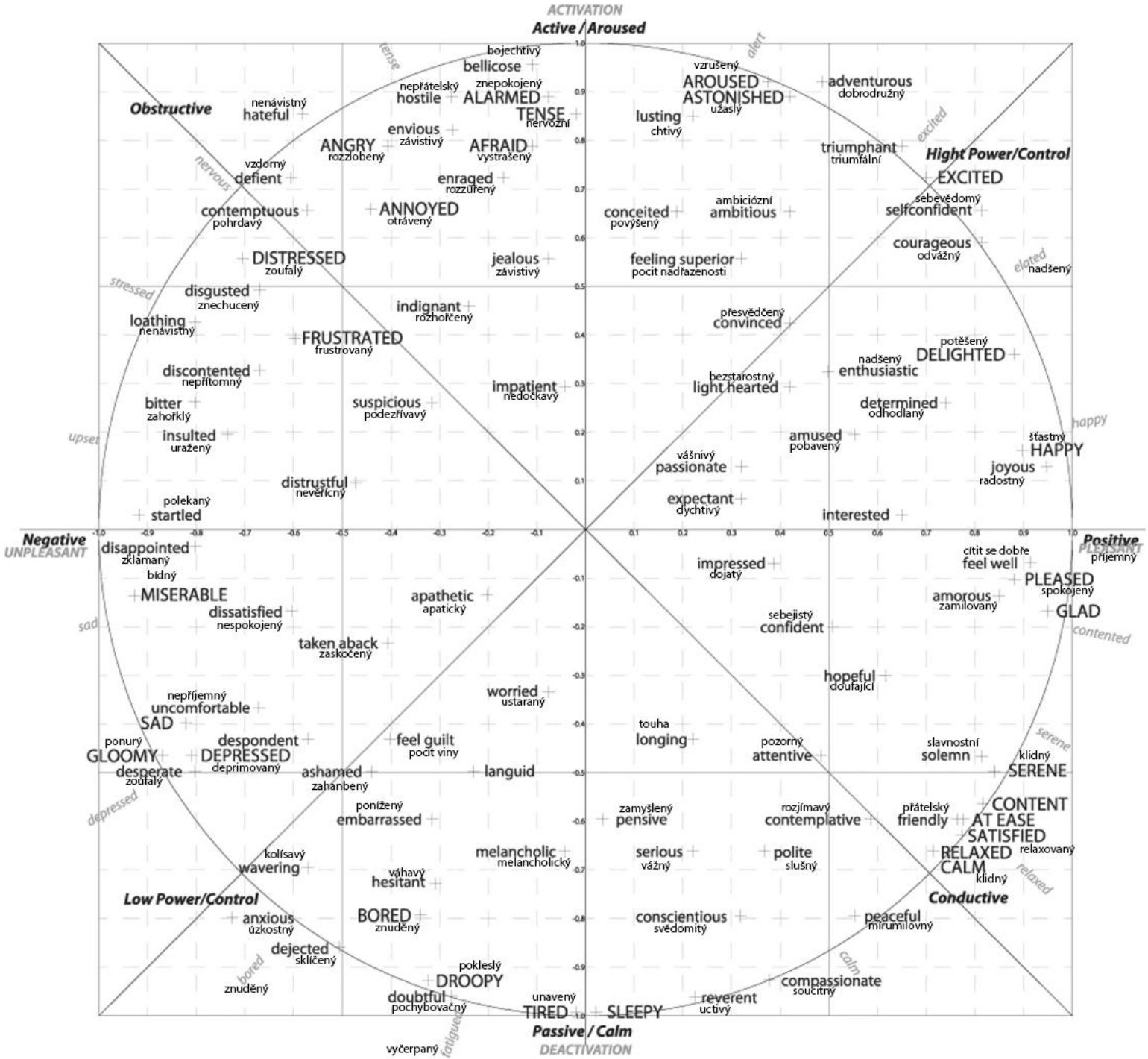
Key assumptions

- Cooperation between **CTU** (new technology), **UP in Olomouc** (subject's condition), **Hydronaut**, 1st Cloud Republic a.s. (commercialization)
- **ESA** space analogue mission requirement
- Mission lengths **min. 1 week**, long flight can be simulated for several weeks (**40 days**)
- It allows to simulate **roles during a mission**, with a landing in the middle of the mission and most importantly with a successful return

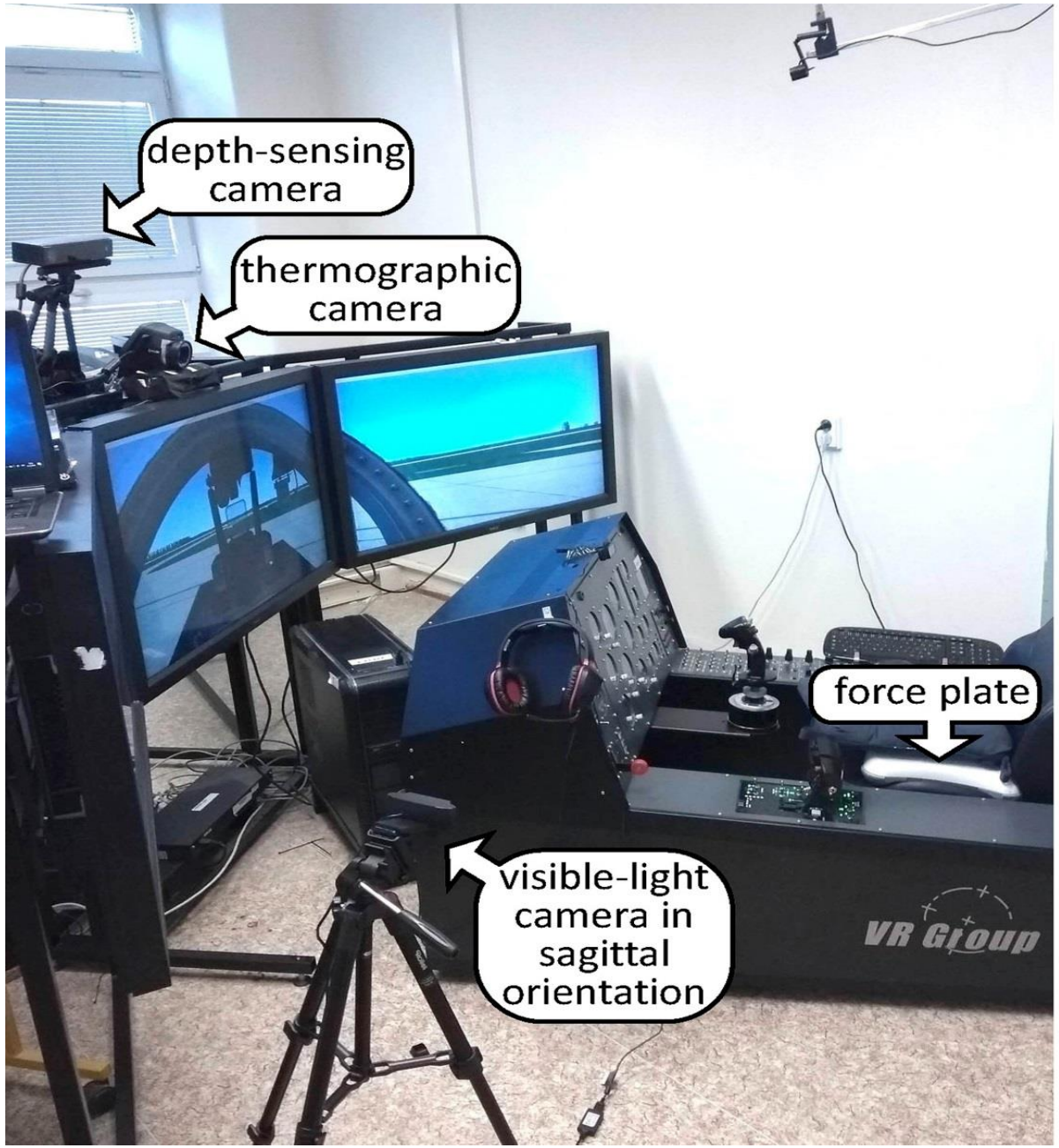
Emotion monitoring

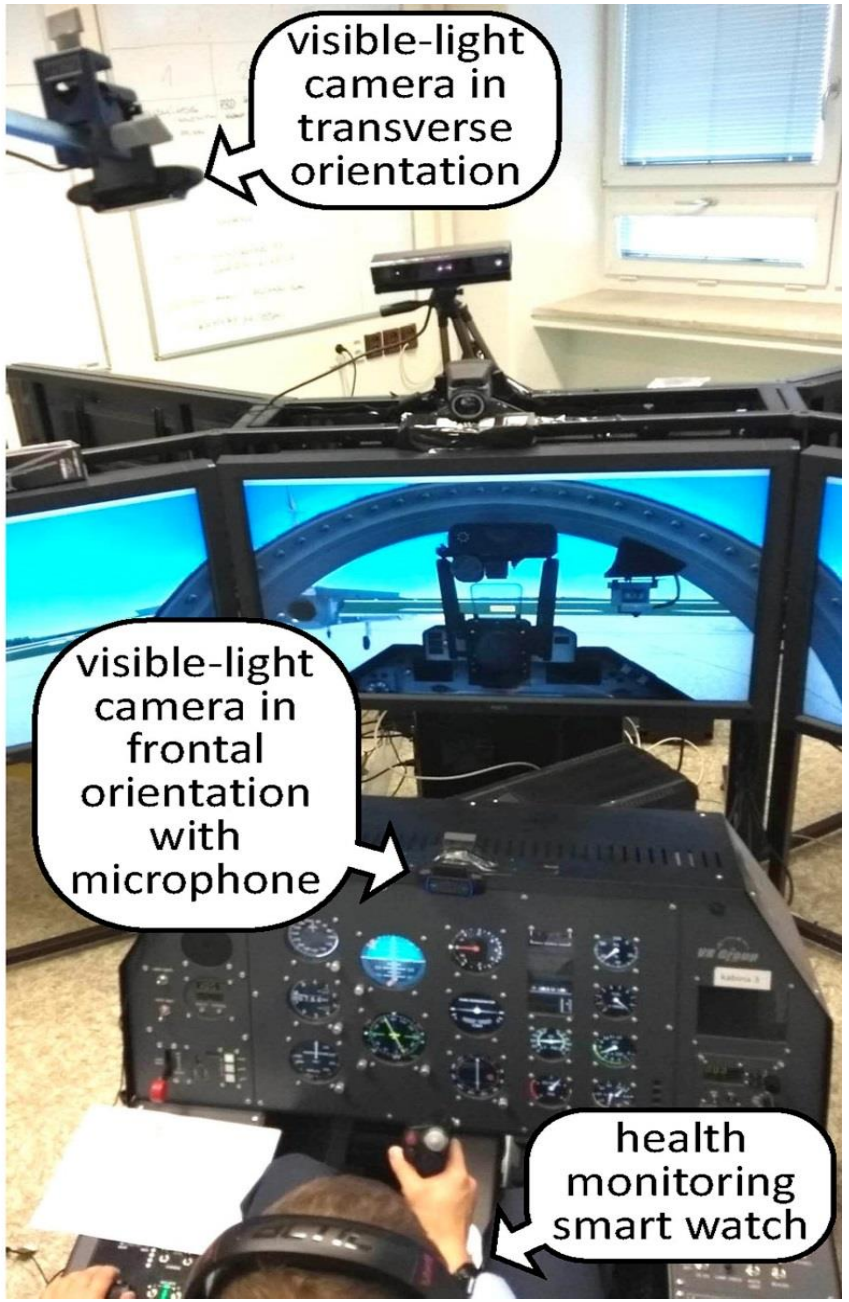
- SW determines the **seven emotions** (+ neutral) communicated by the facial expression
- success rate in 6 cases out of 10

- The 2D valence-arousal model of emotion



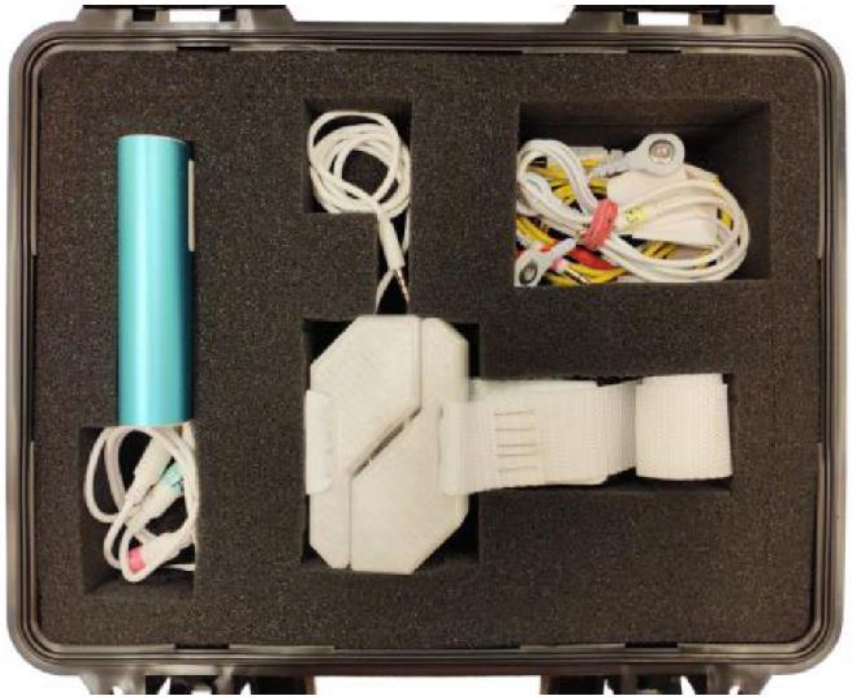
- military application





Cognitive load monitoring

- measurement of physiological data
- **measurement of respiratory activity**
- **measurement of cardiac activity**
- **galvanic skin response measurement**
- **measurement of brain aktivity**
- ……..
- data aggregation and interpretation by artificial intelligence methods



- **evaluation of the team** as a whole
- measurement and evaluation 24/7
- data aggregation and interpretation by artificial intelligence methods

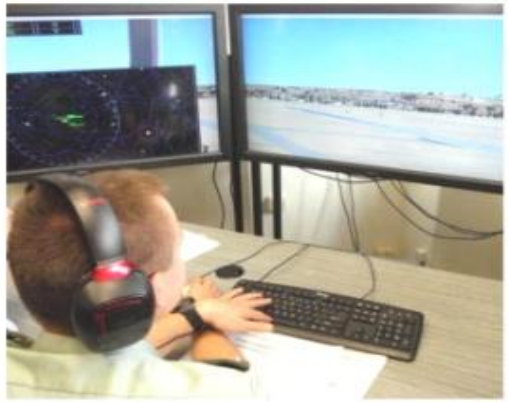
1st pilot

2nd pilot

1st modular sensing unit

2nd modular sensing unit

air traffic controller



3rd modular sensing unit

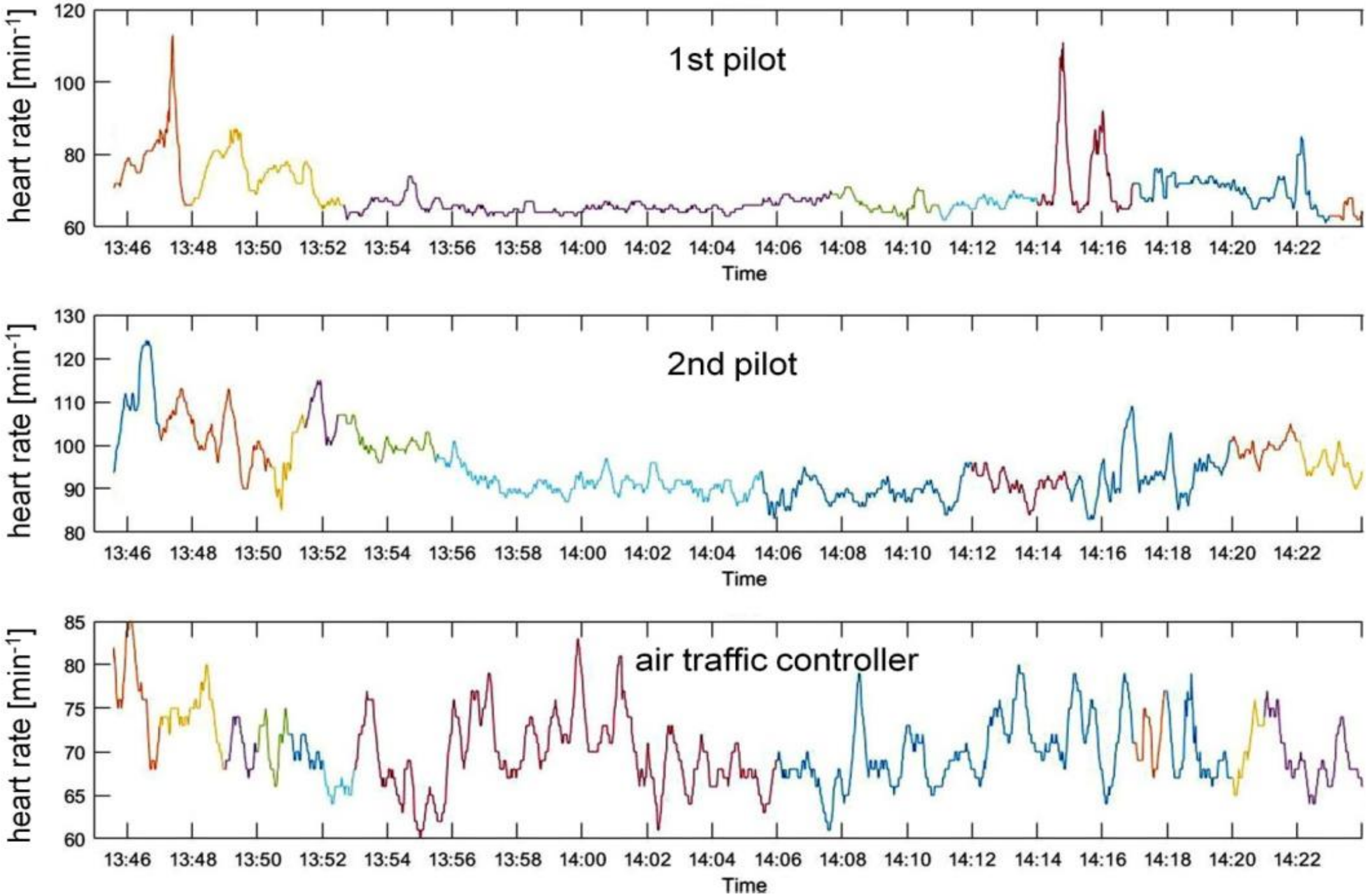
commander

visualization unit

member of ground support

4th modular sensing unit

- **evaluation of the team** as a whole
- measurement and evaluation of data during the mission
- data aggregation and interpretation by artificial intelligence methods


1st pilot
heart rate [min-1]
120
100
80
60
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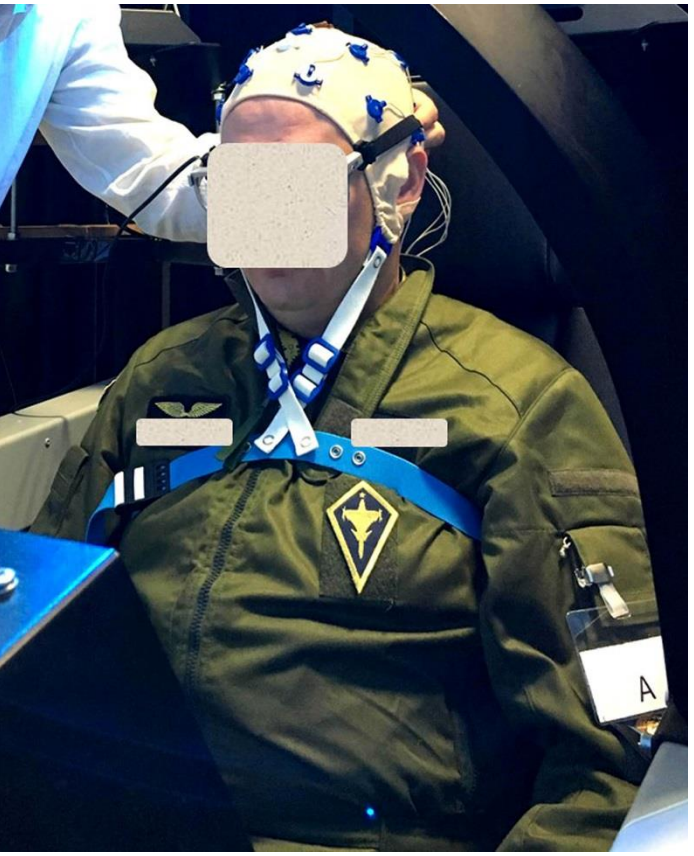
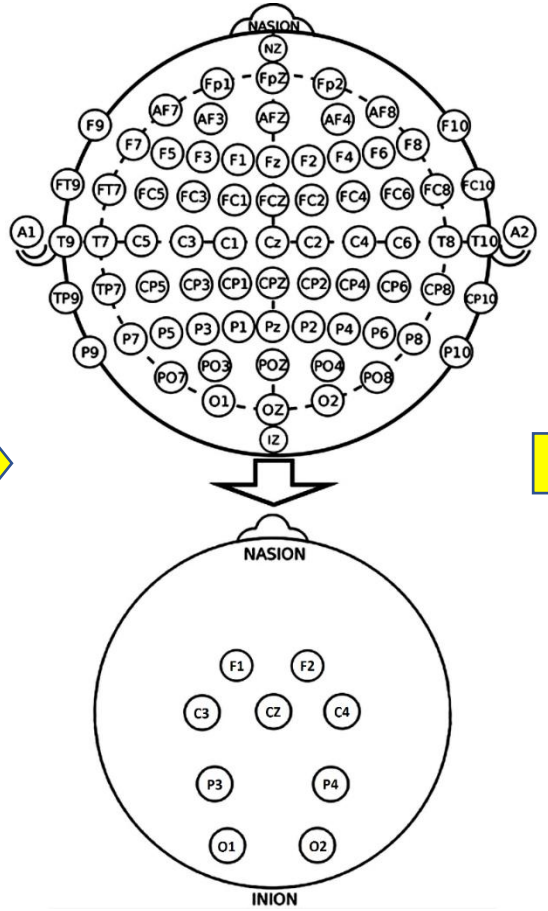
Time
2nd pilot
heart rate [min-1]
130
120
110
100
90
80
13:46 13:48 13:50 13:52 13:54 13:56 13:58 14:00 14:02 14:04 14:06 14:08 14:10 14:12 14:14 14:16 14:18 14:20 14:22
Time
air traffic controller
heart rate [min-1]
85
80
75
70
65
60
13:46 13:48 13:50 13:52 13:54 13:56 13:58 14:00 14:02 14:04 14:06 14:08 14:10 14:12 14:14 14:16 14:18 14:20 14:22
Time

- GUI for displaying measured quantities

CASRI

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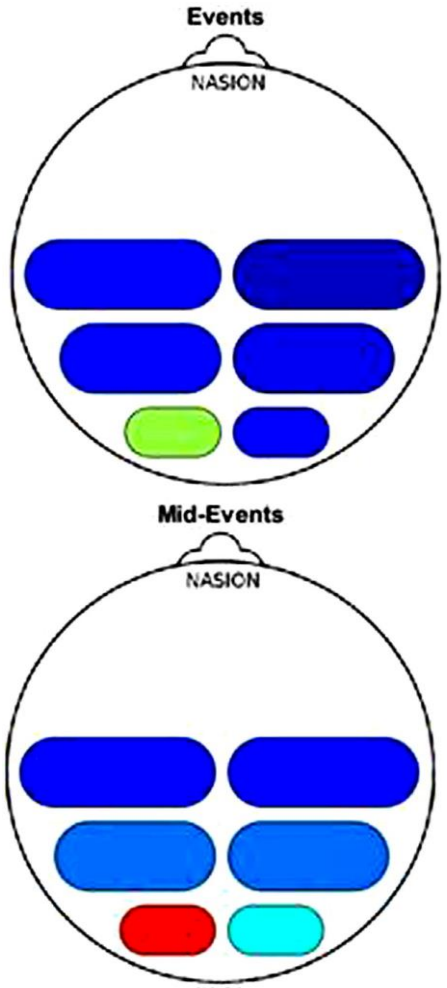
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Mid-Events
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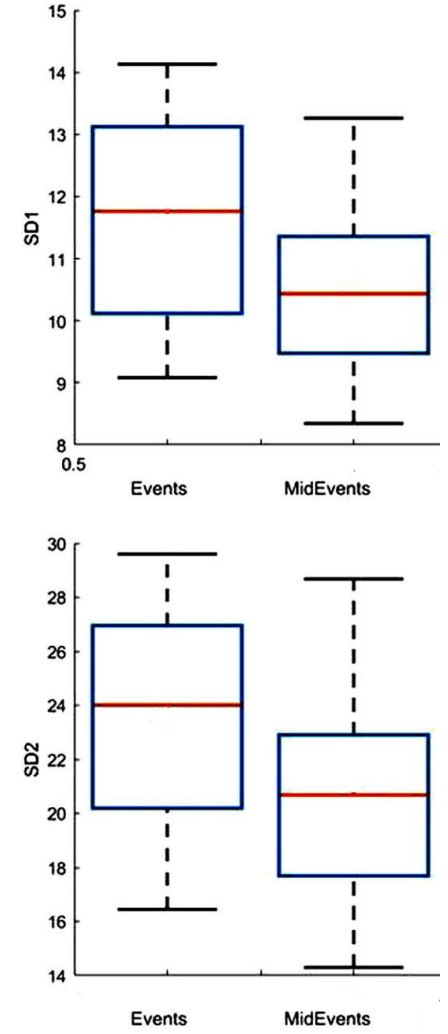
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Events
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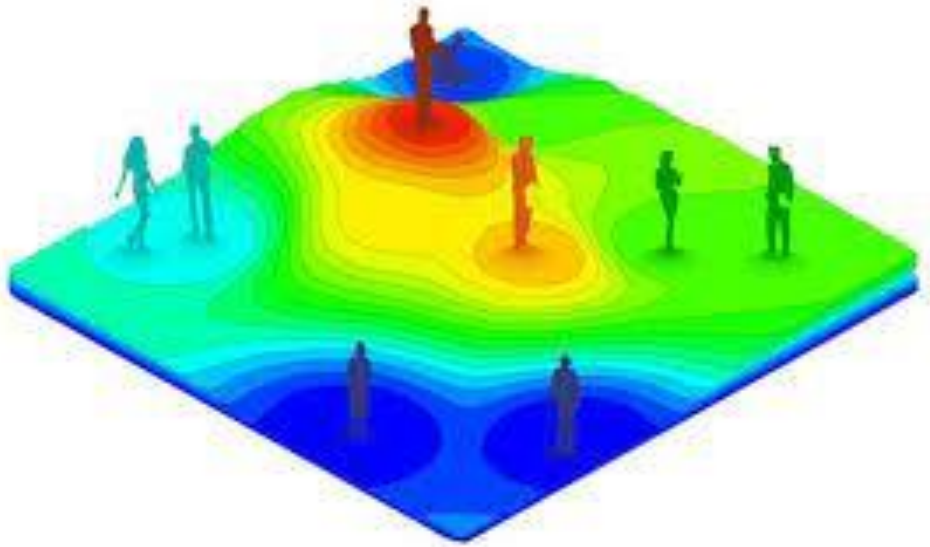
MidEvents

Key areas of psychological and psychophysiological monitoring research

- **Detailed psychodiagnostics** of crew members and support team (neuropsychological personality diagnostics)
- **Team roles and dynamics of team communication** (personality characteristics, sociomapping, interview analysis, face reader, artificial intelligence for emotion recognition)
- **Measurement of mental stress management in the habitat environment and the condition of a member of the support team during the mission** (continuous neuropsychological tests, monitoring of physiological indicators, stress vulnerability of members, measurement mode 24/7)
- **Mental well-being and mental health during a stay in extremely demanding conditions** or within demanding tasks within a mission (interviews, video image analysis, ...)

Our R&D compared to current research projects around the world

- **More detailed** monitoring of executive functions
- **Aggregation of data** from multiple sensors to determine mental state
- Using sociomapping in a demanding underwater environment
- Focus on **complex personality characteristics** determined from physiological data, image records and psychological questionnaires
- Psychophysiological measurement **24/7**
- Using artificial intelligence to recognize emotions



Thanks for your attention