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Studying mental stress factors in occupational safety in the context of the smart factory
September 2020 to December 2021

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in partnership with

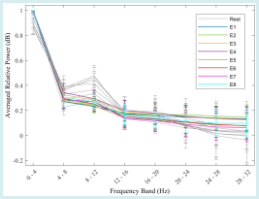
What the project investigated and delivered?

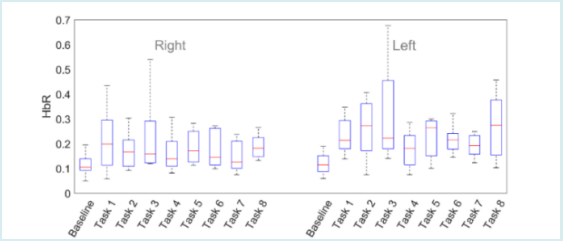
The use of collaborative robots (COBOTs) in the industrial setting continues to grow globally, especially within the context of the smart factory. Humans and COBOTs are increasingly expected to share their workspace and associated issues related to workplace health and safety are expected to rise, including mental stress. Non-invasive neuroimaging data acquisition and processing have enabled us to find the correlations between mental stress and the variations in working environmental conditions. Mental stress and fatigue conditions are correlated with task complexity, speed of work, length of collaborative task and cobot size etc. Mental states often correlate with the brain's alpha rhythms and changes in haemoglobin concentrations and are observable only by a multimodal technique such as EEG+fNIRS. The brain's frontal lobe is associated with decision making, motor control, attention and concentration. The relative frequency band power (FBP) is calculated for the multimodal signals where the alpha band (7.5-13 Hz), indicates a relaxed state of awareness without attention and the beta band (13-26 Hz) is a waking rhythm associated with attention and concentration.

Stress measurement results

Multimodal functional neuroimaging was used to record participants' neural and cardiac activity, along with subjective and behavioral measures as they collaborated with robots in multitasking contexts. Preliminary results show that increasing task complexity is positively correlated with beta and gamma band power, left prefrontal cortex activation and heart rate while it is negatively correlated with alpha band power during task performance. Moreover, beta FBP is highest when all variables are set to high.

Wearable EEG & fNIRS





Papers and future plans

- Studying mental stress factor in occupational safety in the context of the smart factory, 31st ESREL 2021, Angers, France, doi: 10.3850/978-981-18-2016-8_024-cd
- Building trust and safety correlates for autonomous systems using physiological, behavioral, and subjective measures, 13th AHFE 2022, 24-28 July, New York, USA.
- Digital approach to mental wellbeing and occupational safety in smart factory environment, Match funded PhD sponsored by PepsiCo Europe, £66K, 2021.

UKRI Engineering and Physical Sciences Research Council

PepsiCo prioritise staff well-being and this project will allow us to stay ahead in the development of technology associated with good mental health linked to Industry 4.0.
Greg Hilliard – Engineering Innovation Manager, PepsiCo, UK