UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Sensor Fusion in e-Health and mobile-Health

2324-114R004

Title

Sensor Fusion in e-Health and mobile-Health

Teacher(s)

Giulia Cisotto, Ph.D.
Aurora Saibene, Ph.D.

Language

English

Short description

The course aims to present the most important sensor fusion methods for e-Health and mobile-Health, and to give the students the opportunity to implement and test some of these solutions in two simple lab experiences. Particularly, the course will give an introduction of e-Health, m-Health and the most common signals that can be acquired, with particular attention on the motivation for implementing sensor fusion strategies in these contexts. The most relevant solutions for sensor fusion for biological signals (acquired by e.g., EEG, EMG, GSR, ECG..) will be described and discussed through case studies during classes.
Finally, two hands-on lab activities will be proposed, in order for the students to experience challenges and

advantages of sensor fusion in the specific contexts of human activity recognition and emotion recognition.
At the end of the course, the students are supposed to have developed the skills to choose and implement the most suitable solution of sensor fusion for the specific e-/m-health scenario, and to be able to adopt similar solutions in other contexts, too (e.g., autonomous vehicles).

Course contents

- introduction to e-health and m-health (data types, sensors/devices, requirements, main scenarios)
- main data fusion strategies
- basic information on different kinds of biological signals
- review of time and frequency domain analysis
- *case study 1*: gesture recognition using electroencephalography (EEG) and electromyography (EMG)
- *case study 2* (hands-on in lab): stress recognition using EEG, electrodermal activity (EDA), photoplethysmography (PPG)

During the hands-on Matlab-based lab activity, students will perform data acquisition as well as data analysis (single- and multi-modal). The multi-modal data will be processed using three main data fusion strategies.

Final evaluation
A short questionnaire (closed-form questions) will be administerd the last day of the course.
Moreover, either one of the following activities could be chosen:
(1) brief review of the state-of-the-art
(2) short measurement campaign with a final technical report
(3) short experimental project (based on a well-defined research question)
The topic of the above activities will be discussed and agreed with the Professors.

References
[1] Gravina, R., Alinia, P., Ghasemzadeh, H., & Fortino, G. (2017). Multi-sensor fusion in body sensor networks: State-of-the-art and research challenges. Information Fusion, 35, 68-80.
[2] Cisotto, G., Guglielmi, A. V., Badia, L., & Zanella, A. (2018, September). Classification of grasping tasks based on EEG-EMG coherence. In 2018 IEEE 20th International Conference on e-Health Networking, Applications and Services (Healthcom) (pp. 1-6). IEEE.
[3] Tryon, J., Friedman, E., & Trejos, A. L. (2019, June). Performance Evaluation of EEG/EMG Fusion Methods for Motion Classification. In 2019 IEEE 16° International Conference on Rehabilitation Robotics (ICORR) (pp. 971-976). IEEE.
[4] Tryon, J., & Trejos, A. L. (2020). Classification of Task Weight During Dynamic Motion Using EEG–EMG Fusion. IEEE Sensors Journal.
[5] Gasparini, F., Grossi, A., Giltri, M., Nishinari, K., & Bandini, S. (2023). Behavior and Task Classification Using Wearable Sensor Data: A Study across Different Ages. Sensors, 23(6), 3225.
[6] Zyma, I., Tukaev, S., Seleznov, I., Kiyono, K., Popov, A., Chernykh, M., & Shpenkov, O. (2019). Electroencephalograms during mental arithmetic task performance. Data, 4(1), 14.

CFU / Hours

2 credits, equivalent to 20 hours, including classes for **1 credit** (8 hours) and lab activity for **1 credit** (12 hours)

Teaching period

December 2023 (teaching schedule to appear soon)

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION