Daniele Germano

ESPERIENZA LAVORATIVA

Sapienza Università di Roma

Città: Roma | **Paese:** Italia | **Impresa o settore:** Attività professionali, scientifiche e tecniche

[01/12/2022 – Attuale] **Assegnista di ricerca**

Sviluppo di modelli di Intelligenza Artificiale per l'analisi dei biosegnali, quali EEG, ECG e GSR.

Sapienza Università di Roma

Città: Roma | **Paese:** Italia

[01/05/2023 – 31/05/2024] **Tutor universitario**

2 lezioni (10h) di introduzione alla Statistica e al Machine Learning tenute a studenti di Laurea Magistrale in Biotecnologie

Boolean

Città: Milano | **Paese:** Italia

[01/10/2022 – Attuale] **Insegnante nei corsi di qualificazione professionale**

Docente di riferimento per il corso di Data Analytics, per i moduli di Statistica, SQL, Python e Machine Learning

WISHINNOVATION

Città: Rende | **Paese:** Italia

[01/06/2022 – Attuale] **Data-scientist**

Analisi, ideazione e implementazione di modelli di Intelligenza Artificiale in aree quali sostenibilità e sanità.

BrainSigns

Città: Roma | **Paese:** Italia

[01/09/2020 – 31/08/2022] **Data-scientist**

Analisi di biosegnali (ECG, EEG) per l'implementazione di modelli di Intelligenza Artificiale per la detezione e la classificazione di stati mentali, quali carico di lavoro, strees e fatica

Be DigiTech

Città: Roma | **Paese:** Italia

[01/10/2020 – 31/01/2022] **Data-scientist**

Gestione e supervisione di un team di Data Scientist Junior impegnato in progetti di Intelligenza Artificiale per diversi clienti.

Fondazione Santa Lucia

Città: Roma | **Paese:** Italia

[01/09/2019 – 31/07/2020] **Data-scientist**

Internship finalizzato alla stesura dell'elaborato finale della Laurea Magistrale in Data Science. Il lavoro si focalizzava sull'analisi dei dati e l'impiego di metodi di Machine e Deep Learning per la classificazione degli stati mentali (quali, carico mentale e stress).

Jakala

Città: Roma | **Paese:** Italia

[01/09/2018 – 30/09/2020] ### Data-scientist

- Analisi delle specifiche funizonali
- Statistical Matching
- Creazione tool per la Data Privacy

Accenture

Città: Roma | **Paese:** Italia

[01/04/2015 – 31/08/2018] ### Data-scientist

- Data ingestion (HDFS, Cloudera Impala)
- Data processing e Transformation (Spark, Python, Google Cloud Platform)

ISTRUZIONE E FORMAZIONE

[01/11/2023 – Attuale] ### Dottorato di Ricerca in Bioingegneria

Sapienza Università di Roma https://phd.uniroma1.it/web/DANIELE-GERMANO_nP1703802_IT.aspx

Città: Roma | **Paese:** Italia | **Campi di studio:** Salute e assistenza: ● *Programmi e qualifiche interdisciplinari inerenti alla salute e allassistenza ;* Scienze naturali, matematiche e statistiche: ● *Biologia* ● *Statistica* | **Livello EQF:** Livello 8 EQF

Il lavoro di dottorato è incentrato sull'utilizzo di modelli di Machine e Deep Learning per l'analisi di bio-segnali in contesti di Passive Brain Computer Interface

[01/10/2015 – 23/07/2020] ### Laurea Magistrale in Data Science

Sapienza Università di Roma

Città: Roma | **Paese:** Italia | **Campi di studio:** Scienze naturali, matematiche e statistiche: ● *Statistica ;* Tecnologie dell'informazione e della comunicazione (TIC): ● *Sviluppo e analisi di software e applicazioni* | **Voto finale:** 99 | **Livello EQF:** Livello 7 EQF | **Tesi:** Towards passive Brain-Computer Interface employment in everyday-life applications. How to maximize EEG-based mental workload classification performance, through Machine Learning and Deep Learning methods

Principali argomenti affrontati durante gli esami:

- Algoritmi di Machine e Deep Learning
- Neuroscienze
- Statistica
- Python e R
- Bio-informatica e Digital Epidemiology

[15/01/2015 – 30/04/2015] ### Master di primo livello in Big Data

Biogem - UIIP https://www.uiip.it/

Città: Ariano Irpino | **Paese:** Italia | | **Livello EQF:** Livello 7 EQF

[01/10/2011 – 15/10/2014] ### Laurea Triennale in Statistica

Università della Calabria

Città: Rende | **Paese:** Italia | **Campi di studio:** Scienze naturali, matematiche e statistiche: ● *Statistica* | **Voto finale:** 110 e Lode | **Livello EQF:** Livello 6 EQF | **Tesi:** Metodi di Clustering Aggregativi

Principali argomenti affrontati durante gli esami:

- Statistica
- R
- Matematica
- Matematica Finanziaria

COMPETENZE LINGUISTICHE

Lingua madre: italiano

Altre lingue:

inglese

ASCOLTO B2 **LETTURA** B2 **SCRITTURA** B2

PRODUZIONE ORALE B1 **INTERAZIONE ORALE** B1

spagnolo

ASCOLTO B1 **LETTURA** B1 **SCRITTURA** A2

PRODUZIONE ORALE B1 **INTERAZIONE ORALE** B1

Livelli: A1 e A2: Livello elementare B1 e B2: Livello intermedio C1 e C2: Livello avanzato

COMPETENZE

Python | R | Machine Learning | Data Science | SQL | Deep Learning | Git | Neuroscience | Signal Proceccing | Microsoft Office | Data Analysis

PUBBLICAZIONI

[2025]

Brain cortical area characterization and machine learning-based measure of Rasmussen's S-R-K model

Background: the Skill, Rule, and Knowledge (S-R-K) model is a framework used to describe and analyze human behaviour and decision-making in complex environments based on the nature of the task and kind of cognitive control required. The S-R-K model is particularly useful in fields like human factor engineering, system design, and safety-critical industries because it helps to understand human errors and how they relate to different levels of cognitive control. However, the S-R-K model is still qualitative and lacks specific and quantifiable metrics for determining what kind of cognitive control a person is using at any given time. This aspect makes difficult to directly measure and compare performance across the three levels. This study aimed therefore to characterize the S-R-K model from a neurophysiological perspective by analyzing the operator's cerebral cortical activity. Methods: in this study, participants carried out experimental tasks able to replicate the Skill (tracking task), Rule (rule-based navigation) and Knowledge conditions (unfamiliar situations). Results: participants' Electroencephalogram (EEG) was recorded during tasks execution and then Global Field Power (GFP) was estimated in the different EEG frequency bands. Brodmann areas (BAs) and EEG features were then used to characterize the S-R-K pattern over the cerebral cortex and as inputs to build up the machine learning-based model to estimate participants' cognitive control behaviours while dealing with tasks. Conclusions: the results demonstrate the possibility of objectively measuring the different S, R and K levels in terms of brain activations. Furthermore, such evidence is consistent with the scientific literature in terms of cognitive functions corresponding to the different levels of cognitive control.

Autori: D. Amore, D. Germano, G. Di Flumeri, P. Aricò, V. Ronca, A. Giorgi, A. Vozzi, R. Capotorto, S. Bonelli, F. Drogoul, J. Imbert, G. Granger, F. Babiloni, G. Borghini | **Nome della pubblicazione**: Brain Sciences | **Volume, numero, pagine**: vol. 15, issue 9, pages 981 | **Editore**: MDPI

[2025]

Single-Subject Unsupervised Detection of Covariate Shift in EEG: A Step Towards Real-World passive Brain-Computer Interface

Thanks to significant advancements in wearable EEG technology, the application of passive Brain-Computer Interface (pBCI) systems is now becoming feasible in settings beyond the laboratory, such as Industry 5.0, where human machine interaction is central. However, in these real-world and less controlled settings, a common challenge in classifying EEG signals is the variation in EEG headset positioning across sessions, which can induce a phenomenon known as covariate shift, leading to reduced accuracy between training and subsequent recording sessions. This study aims to detect covariate shift, using an unsupervised Machine Learning model (i.e. Isolation Forest), at the single subject level for online applications, focusing on evaluating how quickly the model identifies anomalous records that deviate from the distribution of the control dataset. Simulations were conducted by using different shift conditions (i.e. deviation of the headset position from the original one), to evaluate (i) the performance of the detection model used for identifying the occurrence of covariate shift and (ii) the number of needed data samples to provide a statistically significant detection. The results show that it is possible to detect Covariate Shift in real-time, using less than 20 seconds of recording. This result was obtained in 9 out of 10 participants, across all test configurations and it indicates that with only 20 seconds of recording, the number of anomalies detected by the method is statistically significant compared to the number of anomalies in a control dataset, with a significance level of 5%. Only in one participant the method fails to reach this level of accuracy for two out of three test configurations. This pilot study represents an important step towards the generation of robust and reliable pBCI models for applications in real-world contexts.

Autori: D. Germano, V. Ronca, R. Capotorto, G. Di Flumeri, G. Borghini, A. Giorgi, A. Vozzi, F. Babiloni, P. Aricò | **Nome della pubblicazione**: IX National Congress of Bioengineering, GNB 2025

Towards the Correction of Covariate Shift in EEG-Based Passive Brain-Computer Interfaces for Out-of-Lab Applications

[2025]

The increasing adoption of wearable EEG technology is enabling the development of passive Brain-Computer Interface (pBCI) systems for real-world applications, in the near future, such as Industry 5.0. However, one major challenge in classifying electroencephalographic (EEG) signals in these settings is covariate shift, which occurs when the distribution of the data changes between training and testing sessions due to variations in EEG headset positioning. This study investigates the effectiveness of a linear transformation approach to mitigate the negative effect of covariate shift. Simulations were conducted by using different shift conditions (i.e. deviation of the headset position from the original one), to evaluate (i) the performance of the transformation function used for mitigating the covariate shift occurrence and (ii) the importance that the change of reference and/or channels has on the classification performance. Results show that normalizing covariate shift-affected data (i.e., target) using shift-free data as a template (i.e., source) helps mitigate the negative impact of covariate shift, leading to improved classification performanceThe accuracy loss drops from 14% to 6% in the worst configuration and from 5% to 4% in the best configuration. This improvement is more pronounced when the shift is larger, i.e., when both the reference and channels change between the control dataset and the test dataset. These findings have significant implications for the development of robust and reliable pBCI models for out-of-the-lab contexts.

Autori: D. Germano, V. Ronca, R. Capotorto, G. Di Flumeri, G. Borghini, A. Giorgi, F. Babiloni, P. Aricò | **Nome della pubblicazione**: 47th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)

[2025] **Understanding the Unexplored: A Review on the Gap in Human Factors Characterization for Industry 5.0**

The integration of neurophysiological techniques into Industry 5.0 represents a transformative approach to assessing human factors in real-world operational settings. This study presents a systematic review of existing literature to evaluate the application of neurophysiological methods in assessing cognitive and emotional states, such as workload, stress, attention, and trust, within industrial environments. A total of X peer-reviewed articles published between 2018 and 2024 were analyzed following a structured methodology. The findings reveal that EEG (45%), eye-tracking (30%), EDA (20%), and ECG (15%) are the most frequently adopted techniques for monitoring cognitive and emotional responses. Additionally, 60% of the studies focused on stress and workload assessment, while only 25% examined trust and collaboration in human–robot interaction, highlighting a gap in comprehensive teamwork analysis. Furthermore, only 35% of the studies validated their approaches in real-world industrial settings, emphasizing a significant limitation in ecological validity. The review also identifies that multimodal integration remains underexplored, with just 15% of studies combining multiple neurophysiological signals for a more holistic assessment. These results indicate a growing but still fragmented research landscape, with clear opportunities for expanding real-world applications, improving methodological standardization, and fostering interdisciplinary collaboration. Future research should prioritize validation in dynamic, real-life work environments and explore the synergistic potential of multimodal neurophysiological approaches to enhance human-centred industrial systems.

[2024] [Optimizing EEG Signal Integrity: A Comprehensive Guide to Ocular Artifact Correction](#)

Ocular artifacts, including blinks and saccades, pose significant challenges in the analysis of electroencephalographic (EEG) data, often obscuring crucial neural signals. This tutorial provides a comprehensive guide to the most effective methods for correcting these artifacts, with a focus on algorithms designed for both laboratory and real-world settings. We review traditional approaches, such as regression-based techniques and Independent Component Analysis (ICA), alongside more advanced methods like Artifact Subspace Reconstruction (ASR) and deep learning-based algorithms. Through detailed step-by-step instructions and comparative analysis, this tutorial equips researchers with the tools necessary to maintain the integrity of EEG data, ensuring accurate and reliable results in neurophysiological studies. The strategies discussed are particularly relevant for wearable EEG systems and real-time applications, reflecting the growing demand for robust and adaptable solutions in applied neuroscience.

[2024] [o-CLEAN: a novel multi-stage algorithm for the ocular artifacts' correction from EEG data in out-of-the-lab applications](#)

In the context of electroencephalographic (EEG) signal processing, artifacts generated by ocular movements, such as blinks, are significant confounding factors. These artifacts overwhelm informative EEG features and may occur too frequently to simply remove affected epochs without losing valuable data. Correcting these artifacts remains a challenge, particularly in out-of-lab and online applications using wearable EEG systems (i.e. with low number of EEG channels, without any additional channels to track EOG). *Objective.* The main objective of the present work consisted in validating a novel ocular blinks

artefacts correction method, named multi-stage OCuLar artEfActs deNoising algorithm (o-CLEAN), suitable for online processing with minimal EEG channels. *Approach.* The research was conducted considering one EEG dataset collected in highly controlled environment, and a second one collected in real environment. The analysis was performed by comparing the o-CLEAN method with previously validated state-of-art techniques, and by evaluating its performance along two dimensions: (a) the ocular artefacts correction performance (IN-Blink), and (b) the EEG signal preservation when the method was applied without any ocular artefacts occurrence (OUT-Blink). *Main results.* Results highlighted that (i) o-CLEAN algorithm resulted to be, at least, significantly reliable as the most validated approaches identified in scientific literature in terms of ocular blink artifacts correction, (ii) o-CLEAN showed the best performances in terms of EEG signal preservation especially with a low number of EEG channels. *Significance.* The testing and validation of the o-CLEAN addresses a relevant open issue in bioengineering EEG processing, especially within out-of-the-lab application. In fact, the method offers an effective solution for correcting ocular artifacts in EEG signals with a low number of available channels, for online processing, and without any specific template of the EOG. It was demonstrated to be particularly effective for EEG data gathered in real environments using wearable systems, a rapidly expanding area within applied neuroscience.

Autori: V. Ronca, G. Di Flumeri, A. Giorgi, A. Vozzi, R. Capotorto, D. Germano, N. Sciaraffa, G. Borghini, F. Babiloni, P. Aricò | **Nome della pubblicazione**: Journal of Neural Engineering | **Volume, numero, pagine**: vol. 21, issue 5 | **Editore**: IOP Science

[2024]

[Cooperation objective evaluation in aviation: validation and comparison of two novel approaches in simulated environment](#)

Introduction: In operational environments, human interaction and cooperation between individuals are critical to efficiency and safety. These states are influenced by individuals' cognitive and emotional states. Human factor research aims to objectively quantify these states to prevent human error and maintain constant performances, particularly in high-risk settings such as aviation, where human error and performance account for a significant portion of accidents.

Methods: Thus, this study aimed to evaluate and validate two novel methods for assessing the degree of cooperation among professional pilots engaged in real-flight simulation tasks. In addition, the study aimed to assess the ability of the proposed metrics to differentiate between the expertise levels of operating crews based on their levels of cooperation. Eight crews were involved in the experiments, consisting of four crews of Unexperienced pilots and four crews of Experienced pilots. An expert trainer, simulating air traffic management communication on one side and acting as a subject matter expert on the other, provided external evaluations of the pilots' mental states during the simulation. The two novel approaches introduced in this study were formulated based on circular correlation and mutual information techniques.

Results and discussion: The findings demonstrated the possibility of quantifying cooperation levels among pilots during realistic flight simulations. In addition, cooperation time is found to be significantly higher (p < 0.05) among Experienced pilots compared to Unexperienced ones. Furthermore, these preliminary results exhibited significant correlations (p < 0.05) with subjective and behavioral measures collected every 30 s during the task, confirming their reliability.

Autori: R. Capotorto, V. Ronca, N. Sciaraffa, G. Borghini, G. Di Flumeri, L. Mezzadri, A. Vozzi, A. Giorgi, D. Germano, F. Babiloni, P. Aricò | **Nome della pubblicazione**: Frontiers in Neuroinformatics | **Volume, numero, pagine**: vol. 18 | **Editore**: Frontiers

[2024]

[How Immersed Are You? State of the Art of the Neurophysiological Characterization of Embodiment in Mixed Reality for Out-of-the-Lab Applications](#)

Mixed Reality (MR) environments hold immense potential for inducing a sense of embodiment, where users feel like their bodies are present within the virtual space. This subjective experience has been traditionally assessed using subjective reports and behavioral measures. However, neurophysiological approaches offer unique advantages in objectively characterizing embodiment. This review article explores the current state of the art in utilizing neurophysiological techniques, particularly Electroencephalography (EEG), Photoplethysmography (PPG), and Electrodermal activity (EDA), to investigate the neural and autonomic correlates of embodiment in MR for out-of-the-lab applications. More specifically, it was investigated how EEG, with its high temporal resolution, PPG, and EDA, can capture transient brain activity associated with specific aspects of embodiment, such as visuomotor synchrony, visual feedback of a virtual body, and manipulations of virtual body parts. The potential of such neurophysiological signals to differentiate between subjective experiences of embodiment was discussed, with a particular regard to identify the neural and autonomic markers of early embodiment formation during MR exposure in real settings. Finally, the strengths and limitations of the neurophysiological approach in the context of MR embodiment research were discussed, in order to achieve a more comprehensive understanding of this multifaceted phenomenon.

[2023]

[Unsupervised Detection of Covariate Shift Due to Changes in EEG Headset Position: Towards an Effective Out-of-Lab Use of Passive Brain–Computer Interface](#)

In the field of passive Brain–computer Interfaces (BCI), the need to develop systems that require rapid setup, suitable for use outside of laboratories is a fundamental challenge, especially now, that the market is flooded with novel EEG headsets with a good quality. However, the lack of control in operational conditions can compromise the performance of the machine learning model behind the BCI system. First, this study focuses on evaluating the performance loss of the BCI system, induced by a different positioning of the EEG headset (and of course sensors), so generating a variation in the control features used to calibrate the machine learning algorithm. This phenomenon is called covariate shift. Detecting covariate shift occurrences in advance allows for preventive measures, such as informing the user to adjust the position of the headset or applying specific corrections in new coming data. We used in this study an unsupervised Machine Learning model, the Isolation Forest, to detect covariate shift occurrence in new coming data. We tested the method on two different datasets, one in a controlled setting (9 participants), and the other in a more realistic setting (10 participants). In the controlled dataset, we simulated the movement of the EEG cap using different channel and reference configurations. For each test configuration, we selected a set of electrodes near the control electrodes. Regarding the realistic dataset, we aimed to simulate the use of the cap outside the laboratory, mimicking the removal and repositioning of the cap by a non-expert user. In both datasets, we recorded multiple test sessions for each configuration while executing a set of Workload tasks. The results obtained using the Isolation Forest model allowed the identification of covariate shift in the data, even with a 15-s recording sample. Moreover, the results showed a strong and significant negative correlation between the percentage of covariate shift detected by the method, and the accuracy of the passive BCI system (p-value < 0.01). This novel approach opens new perspectives for developing more robust and flexible BCI systems, with the potential to move these technologies towards out-of-the-lab use, without the need for supervision for use by a non-expert user.

Autori: D. Germano, N. Sciaraffa, V. Ronca, A. Giorgi, G. Trulli, G. Borghini, G. Di Flumeri, F. Babiloni, P. Aricò | **Nome della pubblicazione**: Applied Sciences | **Editore**: MDPI

[2023] **AIR SAFE: leveraging IoT sensors and AI models to foster optimal indoor conditions**

Riferimento: NUMTA 2023

The need of safe and livable indoor environments has intensified recently, given that the majority of people spend most of their time indoor. In addition, the recent COVID-19 pandemic has pushed global authorities to focus more heavily on new human health risks pertaining no longer to outdoor spaces but also to indoor ones. In order to guarantee an optimal indoor environmental quality, monitoring and regulating many variables (such as indoor and outdoor temperature, pollutants concentration, noise, and brightness) is necessary. The high number of variables and the complexity of the system makes it advisable to employ high performance models to predict and control the state of the room environment. In this context, we have developed AIR SAFE, an IoT and AI based infrastructure to monitor and control environmental quality in closed spaces where people stay for long periods of time, such as offices or schoolrooms. AIR SAFE uses Machine Learning models to make predictions of temperature, relative humidity, and CO_2 concentration. These predictions, together with data from a network of IoT sensors, are used to take actions on windows and air condition-ing system with the aim of modifying for the better the room environment. With this contribution we show the results of the AI model we have developed for predicting indoor concentration of CO_2, relative humidity, and temperature. Our Long Short Term Memory (LSTM) model has been tested against literature models. For the prediction of CO_2 concentration and indoor temperature we compared LSTM with Random Forest (RF), Convolutional Neural Network (CNN) and Multi-layer Perceptron (MLP). For relative humidity forecast we compared with RF, support vector regression (SVR) and multi-linear regression (MLR). At first, the performances of the sets of models are examined on simulated data; then, we test the results of the best models on real data. With simulated data RF is the best model for predicting CO_2 concentration and temperature, while LSTM is better at predicting relative humidity. Using real data, the LSTM network performs best at forecasting temperature and relative humidity, while RF remains the best CO_2 concentration predictor.

Autori: M. Viviani, S. Colace, D. Germano, S. Laurita, G. Papuzzo, A. Forestiero

[2023] **A neuroergonomic approach fostered by wearable EEG for the multimodal assessment of drivers trainees**

When assessing trainees' progresses during a driving training program, instructors can only rely on the evaluation of a trainee's explicit behavior and their performance, without having any insight about the training effects at a cognitive level. However, being able to drive does not imply knowing how to drive safely in a complex scenario such as the road traffic. Indeed, the latter point involves mental aspects, such as the ability to manage and allocate one's mental effort appropriately, which are difficult to assess objectively. In this scenario, this study investigates the validity of deploying an electroencephalographic neurometric of mental effort, obtained through a wearable electroencephalographic device, to improve the assessment of the trainee. The study engaged 22 young people, without or with limited driving experience. They were asked to drive along five different but similar urban routes, while their brain activity was recorded through electroencephalography. Moreover, driving performance, subjective and reaction times measures were collected for a multimodal analysis. In terms of subjective and performance measures, no driving improvement could be detected either through the driver's subjective measures or through their driving performance. On the other side, through the electroencephalographic neurometric of mental effort, it was possible to catch their improvement in terms of mental performance, with a decrease in experienced mental demand after three repetitions of the driving training tasks. These results were

confirmed by the analysis of reaction times, that significantly improved from the third repetition as well. Therefore, being able to measure when a task is less mentally demanding, and so more automatic, allows to deduce the degree of users training, becoming capable of handling additional tasks and reacting to unexpected events.

Autori: G. Di Flumeri, A. Giorgi, D. Germano, V. Ronca, A. Vozzi, G. Borghini, L. Tamborra, I. Simonetti, R. Capotorto, S. Ferrara, N. Sciaraffa, F. Babiloni, P. Aricò | **Nome della pubblicazione**: Sensors | **Editore**: MDPI

[2022] **[Evaluation of a new lightweight EEG technology for translational applications of passive brain-computer interfaces](#)**

Technologies like passive brain-computer interfaces (BCI) can enhance human-machine interaction. Anyhow, there are still shortcomings in terms of easiness of use, reliability, and generalizability that prevent passive-BCI from entering real-life situations. The current work aimed to technologically and methodologically design a new gel-free passive-BCI system for out-of-the-lab employment. The choice of the water-based electrodes and the design of a new lightweight headset met the need for easy-to-wear, comfortable, and highly acceptable technology. The proposed system showed high reliability in both laboratory and realistic settings, performing not significantly different from the gold standard based on gel electrodes. In both cases, the proposed system allowed effective discrimination (AUC > 0.9) between low and high levels of workload, vigilance, and stress even for high temporal resolution (<10 s). Finally, the generalizability of the proposed system has been tested through a cross-task calibration. The system calibrated with the data recorded during the laboratory tasks was able to discriminate the targeted human factors during the realistic task reaching AUC values higher than 0.8 at 40 s of temporal resolution in case of vigilance and workload, and 20 s of temporal resolution for the stress monitoring. These results pave the way for ecologic use of the system, where calibration data of the realistic task are difficult to obtain.

Autori: N. Sciaraffa, G. Di Flumeri, D. Germano, A. Giorgi, A. Di Florio, G. Borghini, A. Vozzi, V. Ronca, F. Babiloni, P. Aricò | **Nome della pubblicazione**: Frontiers in Human Neuroscience | **Editore**: Frontiers

[2022] **[Validation of a light EEG-based measure for real-time stress monitoring during realistic driving](#)**

Driver's stress affects decision-making and the probability of risk occurrence, and it is therefore a key factor in road safety. This suggests the need for continuous stress monitoring. This work aims at validating a stress neurophysiological measure—a Neurometric—for out-of-the-lab use obtained from lightweight EEG relying on two wet sensors, in real-time, and without calibration. The Neurometric was tested during a multitasking experiment and validated with a realistic driving simulator. Twenty subjects participated in the experiment, and the resulting stress Neurometric was compared with the Random Forest (RF) model, calibrated by using EEG features and both intra-subject and cross-task approaches. The Neurometric was also compared with a measure based on skin conductance level (SCL), representing one of the physiological parameters investigated in the literature mostly correlated with stress variations. We found that during both multitasking and realistic driving experiments, the Neurometric was able to discriminate between low and high levels of stress with an average Area Under Curve (AUC) value higher than 0.9. Furthermore, the stress Neurometric showed higher AUC and stability than both the SCL measure and the RF calibrated with a cross-task approach. In conclusion, the Neurometric proposed in this work proved to be suitable for out-of-the-lab monitoring of stress levels.

Autori: N. Sciaraffa, G. Di Flumeri, D. Germano, A. Giorgi, A. Di Florio, G. Borghini, A. Vozzi, V. Ronca, R. Varga, M. van Gasteren, F. Babiloni, P.Aricò | **Nome della pubblicazione**: Brain Sciences | **Volume, numero, pagine**: vol. 12, issue 3, pages 304 | **Editore**: MDPI

[2021] **Mental Effort Estimation by Passive BCI: A Cross-Subject Analysis**

Riferimento: 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)

Despite the technological advancements, the employment of passive brain computer interface (BCI) out of the laboratory context is still challenging. This is largely due to methodological reasons. On the one hand, machine learning methods have shown their potential in maximizing performance for user mental states classification. On the other hand, the issues related to the necessary and frequent calibration of algorithms and to the temporal resolution of the measurement (i.e. how long it takes to have a reliable state measure) are still unsolved. This work explores the performances of a passive BCI system for mental effort monitoring consisting of three frontal electroencephalographic (EEG) channels. In particular, three calibration approaches have been tested: an intra-subject approach, a cross-subject approach, and a free-calibration procedure based on the simple average of theta activity over the three employed channels. A Random Forest model has been employed in the first two cases. The results obtained during multi-tasking have shown that the cross-subject approach allows the classification of low and high mental effort with an AUC higher than 0.9, with a related time resolution of 45 seconds. Moreover, these performances are not significantly different from the intra-subject approach although they are significantly higher than the calibration-free approach. In conclusion, these results suggest that a light (three EEG channels) passive BCI system based on a Random Forest algorithm and cross-subject calibration could be a simple and reliable tool for out-of-the-lab employment.

Autori: N. Sciaraffa, D. Germano, A. Giorgi, V. Ronca, A. Vozzi, G. Borghini, G. Di Flumeri, F. Babiloni, P. Aricò

VOLONTARIATO

[01/10/2000 – Attuale] **Scout**   Rende

CONFERENZE E SEMINARI

[15/09/2025 – 18/09/2025] **XLIV Scuola Annuale GNB – Unlocking the Mind and Emotions**   Pisa

Partecipazione alla Summer School in qualità di studente

Link: https://www.grupponazionalebioingegneria.it/en/call/xliv-scuola-annuale-gnb-unlocking-the-mind-and-emotions-pisa-15-18-09-2025/

[01/08/2025 – 04/08/2025] **International Research and Industry Symposium on AI**   Montefiascone

Speaker durante la sessione di dibattito pubblico a tema Intelligenza Artificiale

Link: https://iris-ai.org/

[14/07/2025 – 17/07/2025] **47th Annual International Conference of the IEEE Engineering in Medicine and Biology Society**
  Copenhagen

Presentazione dei risultati di uno studio

Link: https://embc.embs.org/2025/

[16/06/2025 – 18/06/2025] **IX Congress of the National Group of Bioengineering (GNB)**   Palermo

Presentazione dei risultati di uno studio durante la sessione poster

Link: https://www.gnb2025.it/

[28/04/2025 – 07/05/2025] **BCI & Neurotechnology Spring School 2025**   Online

Partecipazione alla Spring School organizzata da G-Tec, sul tema delle neuroscienze, in qualità di studente

Link: https://www.gtec.at/bci-neurotech-spring-school-2025/

[22/09/2024 – 27/09/2024] **LOD ACAIN Summer School** Castiglione della Pescaia

Partecipazione alla Summer School e alla successiva conferenza in qualità di uditore

Link: https://acain2024.icas.events/

[16/08/2024 – 19/09/2024] **GNB XLIII Annual School 2024** Bressanone

Partecipazione alla summer School a tema Neuroscienze in qualità di studente

Link: https://www.grupponazionalebioingegneria.it/gnbevent/xliii-annual-school-2024-neurotechnologies-to-understand-and-restore-the-nervous-system/

[22/04/2024 – 01/05/2024] **BCI & Neurotechnology Spring School** Online

Partecipazione alla Spring School organizzata da G-Tec, sul tema delle neuroscienze, in qualità di studente

Link: https://www.gtec.at/spring-school-2024/

[06/11/2023 – 09/11/2023] **22nd International Conference of AIxIA** Roma

Presentazione di un articolo durante un focus group riguardo l'uso dell'Intelligenza Artificiale nelle Neuroscienze

Link: https://www.aixia2023.cnr.it/

RETI E AFFILIAZIONI

[01/01/2025 – Attuale] **IEEE** New York

[01/01/2024 – Attuale] **National Group of Bioengineering (GNB)** Milano

Il GNB - Gruppo Nazionale di Bioingegneria è un'associazione senza fini di lucro con finalità scientifiche, culturali, informative e sociali volte a promuovere, sponsorizzare e coordinare studi, ricerche e dibattiti sulla bioingegneria.

Link: https://www.grupponazionalebioingegneria.it/it/

[01/01/2023 – Attuale] **Associazione Italiana per l'Intelligenza Artificiale (AIxIA)** Roma

L'Associazione Italiana per l'Intelligenza Artificiale (AIxIA) è un'associazione scientifica senza scopo di lucro fondata nel 1988 con l'obiettivo di promuovere la ricerca e la diffusione delle tecniche legate all'Intelligenza Artificiale.

Link: https://aixia.it/en/