Daniele Germano

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ESPERIENZA LAVORATIVA

01/12/2022 – ATTUALE Roma, Italia
ASSEGNISTA DI RICERCA SAPIENZA UNIVERSITÀ DI ROMA

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

Impresa o settore Attività professionali, scientifiche e tecniche

01/05/2023 – 31/05/2024 Roma, Italia
TUTOR UNIVERSITARIO SAPIENZA UNIVERSITÀ DI ROMA

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

01/10/2022 – ATTUALE Milano, Italia
INSEGNANTE NEI CORSI DI QUALIFICAZIONE PROFESSIONALE BOOLEAN

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

01/06/2022 – ATTUALE Rende, Italia
DATA-SCIENTIST WISHINNOVATION

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

01/09/2020 – 31/08/2022 Roma, Italia
DATA-SCIENTIST BRAINSIGNS

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

01/10/2020 – 31/01/2022 Roma, Italia
DATA-SCIENTIST BE DIGITECH

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

01/09/2019 – 31/07/2020 Roma, Italia
DATA-SCIENTIST FONDAZIONE SANTA LUCIA

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).

01/09/2018 – 30/09/2020 Roma, Italia
DATA-SCIENTIST JAKALA

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

01/04/2015 – 31/08/2018 Roma, Italia
DATA-SCIENTIST ACCENTURE

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

ISTRUZIONE E FORMAZIONE

01/11/2023 – ATTUALE Roma, Italia
DOTTORATO DI RICERCA IN BIOINGEGNERIA Sapienza Università di Roma

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

Sito Internet https://phd.uniroma1.it/web/DANIELE-GERMANO_nP1703802_IT.aspx |

Campo di studio Programmi e qualifiche interdisciplinari inerenti alla salute e allassistenza, Biologia, Statistica |

Livello EQF Livello 8 EQF

01/10/2015 – 23/07/2020 Roma, Italia
LAUREA MAGISTRALE IN DATA SCIENCE Sapienza Università di Roma

Principali argomenti affrontati durante gli esami:

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

Campo di studio Statistica, 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

15/01/2015 – 30/04/2015 Ariano Irpino, Italia
MASTER DI PRIMO LIVELLO IN BIG DATA Biogem - UIIP

Sito Internet https://www.uiip.it/ | **Livello EQF** Livello 7 EQF

01/10/2011 – 15/10/2014 Rende, Italia
LAUREA TRIENNALE IN STATISTICA Università della Calabria

Principali argomenti affrontati durante gli esami:

- Statistica
- R
- Matematica
- Matematica Finanziaria

Campo di studio Statistica | **Voto finale** 110 e Lode | **Livello EQF** Livello 6 EQF | **Tesi** Metodi di Clustering Aggregativi

COMPETENZE LINGUISTICHE

Lingua madre: **ITALIANO**

Altre lingue:

	COMPRENSIONE		ESPRESSIONE ORALE		SCRITTURA
	Ascolto	Lettura	Produzione orale	Interazione orale	
INGLESE	B2	B2	B1	B1	B2
SPAGNOLO	B2	B2	B1	B1	B1

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

COMPETENZE DIGITALI

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

PUBBLICAZIONI

2024

Optimizing EEG Signal Integrity: A Comprehensive Guide to Ocular Artifact Correction

Autori:
V. Ronca, R. Capotorto, G. Di Flumeri, A. Giorgi, A. Vozzi, D. Germano, V. Di Virgilio, G. Borghini, G. Cartocci, D. Rossi, B. MS Inguscio, F. Babiloni, P. Aricò

Abstract:
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.

Bioengineering (MDPI)

2024

o-CLEAN: A novel multi-stage algorithm for the ocular artifacts' correction from EEG data in out-of-the-lab applications

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

Abstract:
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.

Journal of Neural Engineering

2024

Cooperation objective evaluation in aviation: Validation and comparison of two novel approaches in simulated environment

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

Abstract:

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.

Frontiers in Neuroinformatics

2024

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

Autori:
V. Ronca, A. Ricci, R. Capotorto, L. Di Donato, D. Freda, M. Pirozzi, E. Palermo, L. Mattioli, G. Di Gironimo, D. Coccorese, S. Buonocore, F. Massa, D. Germano, G. Di Flumeri, G. Borghini, F. Babiloni, P. Aricò

Abstract:
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.

Applied Sciences (MDPI)

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

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

Abstract:
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.

Applied Sciences (MDPI)

2023

AIR SAFE: leveraging IoT sensors and AI models to foster optimal indoor conditions

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

Abstract:

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 CO2 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 CO2, relative humidity, and temperature. Our Long Short Term Memory (LSTM) model has been tested against literature models. For the prediction of CO2 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 CO2 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 CO2 concentration predictor.

NUMTA 2023

2023

A neuroergonomic approach fostered by wearable EEG for the multimodal assessment of drivers trainees

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

Abstract:

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.

Sensors (MDPI)

2022

Evaluation of a new lightweight EEG technology for translational applications of passive brain-computer interfaces

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

Abstract:

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.

Frontiers in Human Neuroscience

2022

Validation of a light EEG-based measure for real-time stress monitoring during realistic driving

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

Abstract:

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.

Brain Sciences

2021

Mental Effort Estimation by Passive BCI: A Cross-Subject Analysis

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

Abstract:

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.

43rd Annual International Conference of the IEEE

VOLONTARIATO

01/10/2000 – 30/09/2022 Rende
Scout

CONFERENZE E SEMINARI

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

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

Link https://acain2024.icas.events/

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

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 Online
BCI & Neurotechnology Spring School

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 Roma
22nd International Conference of AIxIA

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

01/01/2024 – ATTUALE Milano
National Group of Bioengineering (GNB)

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 Roma
Associazione Italiana per l'Intelligenza Artificiale (AIxIA)

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/

Autorizzo il trattamento dei miei dati personali presenti nel CV ai sensi dell'art. 13 d. lgs. 30 giugno 2003 n. 196 - "Codice in materia di protezione dei dati personali" e dell'art. 13 GDPR 679/16 - "Regolamento europeo sulla protezione dei dati personali".