Curriculum Vitae - Jessica Leoni
Updated: 25 May 2023

Personal data

Name: Jessica Leoni
Date of birth: November 24, 1995
Place of birth: Treviglio (BG), Italy
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Position

May 2023 - Ongoing
Junior Assistant Professor (RTDA)
Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB)
Politecnico di Milano, Milano, Italy

January 2023 - May 2023
Postdoctoral Research Fellow^
Dipartimento di Elettronica, Informazione e Bioingegneria (DEIB)
Politecnico di Milano, Milano, Italy

Education

Ph.D. in Data Analytics and Decision Sciences (DADS)   Dec. 2022
Politecnico di Milano, Milano, Italy

Thesis title: A Machine Learning-Based Framework for Automatic and Interpretable Health and Usage
Monitoring of Safety-Critical Air and Ground Vehicles
Advisor: Prof. Mara Tanelli
Grade: Awarded *cum laude*

M.Sc. in Bioengineering   Aug. 2019
University of Illinois at Chicago, Chicago, Illinois

M.Sc. in Information Bioengineering   Jul. 2019
Politecnico di Milano, Milano, Italy
Thesis title: Time-Series Processing and Classification for the Automatic Assessment
of Wild Animals Activities
Advisors: Prof. Tanya Berger-Wolf, Prof. Mara Tanelli, Prof. Silvia Carla Strada
Grade: 110/110 *cum laude*
GPA: 4.0

B.Sc. in Biomedical Engineering   Jul. 2017
Politecnico di Milano, Milano, Italy
Thesis title: WhAlly - Different implementations of the Burrows Wheeler Alignment,
Comparison and Analysis
Advisor: Prof. Marco Domenico Santambrogio
Grade: 110/110 *cum laude*

Diploma di Maturità Scientifica   Jul. 2014
Liceo Scientifico Lorenzo Mascheroni, Bergamo, Italy
Grade: 95/100 *cum laude*

Brief Description of Research Activity

Safety-Oriented Monitoring and Control Systems Design for Urban.Mobility Vehicles

Urban-mobility vehicles play a leading role as transport means, but at a tremendous social cost due to their riskiness. Among the several challenges that must be faced to improve PTW safety, one prominent is their complex nonlinear dynamics that prevent traditional model-based approaches from being effective. Therefore, I am researching on innovative machine-learning safety-oriented monitoring systems to detect dangerous patterns leading to accidents and prevent them, whether possible. In more detail, consider the following:

- endogenous factors, such as the vehicle usage and mechanical specifications [JP1, C4];
- exogenous factors, as the rider driving style, and the road surface roughness [CS2, CS3].

Design of Data-driven Health and Usage Monitoring Systems

Mechanics and electronics advancements of the last decades led to more sophisticated vehicles, often characterized by nonlinear dynamics, which are challenging to model. This is particularly true when considering extreme behaviors as those characterizing anomalies. The lack of reliable models compromises an effective diagnostics and prognostics monitoring system. Therefore, I research applying state-of-the-art machine- and deep-learning techniques to produce interpretable health and usage monitoring platforms. In more detail, I mainly consider helicopters, focusing on the following:

- health monitoring functionalities, as transmission vibration and engine monitoring [J3, F1];
- usage functionalities, as regimes recognition [J4, F2]

Psychophysiological State Estimation

More and more researches reveal that the psychophysiological state of a subject dramatically impacts work performance. The psychophysiological state is the outcome of the individual cognitive processes influenced by internal and external factors. An accurate psychophysiological state assessment is feasible in clinical laboratories, as it requires cumbersome acquisition setup and controlled conditions. However, I believe that a daily-life estimation of the individual's state is required to improve her/his awareness and provide a prompt response to dire conditions, whether detected. Therefore, I research noninvasive psychophysiological state estimation systems capable of real-time reporting an accurate index that relies on physiological, behavioral, and environmental features. These features are extracted from a set of signals acquired by a minimal experimental setup. In more detail, I design the following:

- practical and confortable hardware solutions to retrieve the signals of interest [C1];
- effective methodlogies to combine the information collected in a synthetic and interpretable index that measure the psychophysiological state of the subject.

Brain-Computer Interfaces

Brain-computer interfaces (BCIs) aim to directly bridge the human brain with external devices without requiring peripheral muscular activity. They were introduced to support patients affected by severe muscular diseases, such as locked-in syndrome and amyotrophic lateral sclerosis, in communicating with the external world. Most BCI resort to electroencephalogram (EEG) analysis to identify patterns and map them to a specific word. Despite technology advances, open challenges have still to be faced, as the prompt identification of the deflection which signals that the subject has processed a trigger, *i.e.,* the so-called P300, and the correct map between the shape of an event-related potential (ERP) generated by the stimulus perception and the corresponding stimulus. As model-based approaches are scarcely applicable in this scenario, I research machine-learning systems to perform mind reading, also proposing novel data representations to improve detection and classification performances [J5, J2, C3]

Other research activities (with at least one publication)

- activity recognition [J1, C2]

Participation in Research Groups

During my master's thesis, I become part of the mOve research group of Politecnico di Milano. I also attended the Ph. D. as a member of this group and still work as a research assistant there. During these years, I have been part of several projects, some of which are currently ongoing. I have gained experience over the years. This allowed me to move from dealing with specific technical tasks to being more involved in project management and the supervisor of more junior team members. To date, I am part of the team for all the projects listed below, and I also am the responsible of day-by-day research activies coordination and supervision.

Soluzione data-driven per l'apprendimento automatico dello stato psicofisico del pilota.
Funding Source: Leonardo Velivoli
Duration: Mar 2022 - Mar 2023

Support for the industrialization of the Transmission Vibration Monitoring for helicopters' transmissions.
Funding Source: Leonardo Helicopter Division
Duration: June-Nov 2022

Support for the industrialization of the Flight Condition Recognition algorithm for the AW139 Helicopters.
Funding Source: Leonardo Helicopter Division
Duration: Jan-June 2022

Data Valorization platform to support the digital services of Leonardo Helicopters Division.
Funding Source: Leonardo Helicopter Division
Duration: April-Dec 2022

EDDY: a micro-mobility system based on smart e-Scooters.
Funding Source: Officine Edison and PoliHUB
Duration: Dec 2019 – Dec 2022

Machine-learning approaches to the automatic classification of maneuvers.
Funding Source: Leonardo Helicopter Division
Duration: Apr 2019- Apr 2020

Data-driven approaches for the state-of-health monitoring of rotating parts in helicopters
Funding Source: Leonardo Helicopter Division
Duration: May 2019- Nov 2020

Teaching Activities

Lecturer

Companies Formation Courses OMRON: Education on Databases and Python Programing for Amazon Inc. *Academic Year*: 2023
Class Hours per Year: 12
University: MADE Competence Center for Industry 4.0 (Italy)

Executive Post-Lauream Courses
Executive Program on Digital Mindset & Business Analytics for Leonardo S.p.A. Helicopters Division
Academic Year: 2021/2022
Class Hours per Year: 6
University: Graduate School of Business of Politecnico di Milano (Italy)

Master Program R&D Excellence for Pirelli S.p.A.
Academic Year: 2021/2022
Class Hours per Year: 3
Company: Politecnico di Milano (Italy)

Assistant Lecturer

Bachelor
Fundamentals of Automatic Control
Academic Year: 2020/2021 - 2021/2022 - 2022/2023
Teacher: Prof. P. E. Bolzern
Class Hours per Year: 25 - 26 - 20
University: Politecnico di Milano (Italy)

Fundamentals of C Programming
Teacher: Prof. D.M. Braga
Academic Year: 2021/2022 - 2022/2023
Class Hours per Year: 40 - 28
University: Politecnico di Milano (Italy)

Tutorships

Bachelor
Fundamentals of Automatic Control
Teacher: Prof. M. Tanelli
Academic Year: 2021/2022 - 2022/2023
Class Hours per Year: 20 - 10
University: Politecnico di Milano (Italy)

Fundamentals of Automatic Control - Matlab Labs
Teacher: Prof. M. Tanelli
Academic Year: 2021/2022 - 2022/2023
Class Hours per Year: 9 - 9
University: Politecnico di Milano (Italy)

Fundamentals of Automatic Control - Matlab Labs
Teacher: Prof. P.E. Bolzern
Academic Year: 2019/2020
Class Hours per Year: 12
University: Politecnico di Milano (Italy)

Fundamentals of Automatic Control - Practical Labs
Teacher: Prof. G. Panzani
Academic Year: 2019/2020
Class Hours per Year: 10
University: Politecnico di Milano (Italy)

Co-Advisor of M. Sc. Dissertations

<u>Master Thesis</u>

Methods of automatic analysis for helicopter maneuvers to classification optimization of flight regimes, F. Caroli. *M.Sc. program in Automation Engineering*, Politecnico di Milano, co-advised with: Prof. M. Tanelli, E. Villa **(Dec. 2022)**

Safety-oriented, real-time algorithms for terrain recognition and driving riskiness estimation in e-scooters, M. Capaldo. *M.Sc. program in Computer Science Engineering*, Politecnico di Milano, co-advised with: Prof. M. Tanelli, S. Strada, S. Savaresi **(Dec. 2021)**

Safety-oriented real-time algorithms for road quality, driver mass and number of passengers estimation in urban eScooters, J. Paris. *M.Sc. program in Automation Engineering*, Politecnico di Milano, co-advised with: Prof. M. Tanelli, S. Strada, S. Savaresi **(Dec. 2020)**

National and International Awards and Prizes

Winner of the Call *Il Futuro Parte da Qui*
by Sedici Media he project "FairMOVE, artificial intelligence for a smart, multimodal, sustainable and inclusive mobility", in collaboration with: Prof. M. Tanelli, E. Villa. The project was presented durin EXPO2020 Dubai at Italy Pavillon (**Mar. 2022**)

Winner of the 1st *Leonardo Solvers Wanted Challenge: Pilot performance monitoring*
awarded by Leonardo S.p.a. to the project "POLIMonitor: a data-driven solution to learn the psycho-physiological state of pilots", in collaboration with: Prof. M. Tanelli, J. Leoni, E. Villa (**Feb. 2022**)

Additional Courses and Certifications

Coursera   **Apr. 2020 - Apr .2022**

Course: Big Data Emerging Technologies
University: Yonsei University
Course ID: ZL2HB6FWEU9X
Date: Apr. 2022

Course: Advanced Machine Learning and Signal Processing
Company: IBM
Course ID: DCE9363RC4AZ
Date: May 2020

Course: Ethics in Data Science
University: University of Michigan
Course ID: 64VK52G4WGZY
Date: May 2020

Course: Neural Networks and Deep Learning
Company: Deeplearning.ai
Course ID: JA4RJ79EUAEP
Date: May 2020

Course: Introduction to Psychology
University: Yale University
Course ID: PSUHKVDDU99Q
Date May 2020

Course: Introduction to Data Science in Python
University: University of Michigan
Course ID: CQ6GFXL6M3TK
Date: Apr. 2020

Course: Introduction to Philosophy
University: University of Edinburgh
Course ID: ZJHY7MGR6JTC
Date: Apr. 2020

Esame di Stato, Senior Engineer   **Jul. 2021**
Politecnico di Milano, Milano, Italy

ReglML2020 - Regularization Methods for Machine Learng   **Jun. 2020**
Uiversità di Genova and MIT, Genoa (held in remote), Italy

Industrial Collaborations

Leonardo S.p.A. - Aircraft Division (since Feb. 2022 - Ongoing)

Leonardo S.p.A. - Helicopters Division (since Jan. 2019 - Ongoing)

Edison S.p.A. (Jan 2019 - Jul 2021)

Participations to Scientific Events

Hackathon

– Mockflow Development Tutor of *HackHer - Technology and Inclusion*, 2nd Edition, Castello Sforzesco, Milan (MI), Italy 2022.
– Organizer and Scratch Tutor of *Hackathon Energy Efficiency*, STEM in the city for womENcourage, ENI, San Donato Milanese (MI), Italy 2019.
– Participant of *International womENcourage 2019 ACM Celebration of Women in Engineering Hackathon*, womENcourage, Rome (RO), Italy 2019.

Workshops

– Mobile Application and AI Tools Development Tutor of *Coding Girls*, by Fondazione Mondo Digitale, 7th Edition, Online 2022.
– Scratch Tutor of *Girls in Control*, 21th Edition of IFAC World Congress, 2021.

Conferences Attendance and Paper Presentation

– "10th IFAC Symposium: Advances in Automotive Control", Columbus, OH, USA, August 28-31, 2022.
– "1st International Conference on Human-Machine Systems", Rome (held virtually), Italy, September 7-9, 2020.
– "34th IEEE International Symposium on Parallel and Distributed Processing Workshops and Phd Forum (IPDPSW)", New Orleans, LA (held in hybrid mode), USA, May 18-20, 2020.

Editorial Activities

Reviews

Since 2019, I have served as a reviewer for IEEE Transaction on Automatic Control, Machine Learning with Applications, Expert Systems with Applications, and for several IEEE/IFAC conferences.

Memberships

- IEEE Women in Engineering Student Branch Affinity Group of Politecnico di Milano Member, Sep. 2019 - Ongoing
- IEEE Women in Engineering Member, Feb. 2017-Ongoing
- IEEE Student Member, IEEE Young Professionals Member, IEEE Computer Society Member and IEEE Engineering in Medicine and Biology Society Member, Jan. 2017-Dec. 2020

Personal Skills, Competencies and Activities

Languages

- Italian (Mother tongue), English (C1 level, IELTS, 2018)

Computer Skills and Competences

- Operative Systems: Windows, Mac OS
- Software Packages: Office, Matlab, Anaconda, Jupyter
- Programming: Python, C, C++, Scratch, SQL

Personal Interests

- Climbing
- Karate
- Umanistic subjects

Voluntary Work

- Senza Margini - Emergenza Freddo, 2021-Ongoing
- Croce Bianca Italiana, 2014-2016

Publications

International journals

Published/accepted

[J5] J. LEONI, M. Tanelli, S.C. Strada, A. Brusa, A.M. Proverbio, *Single-Trial Stimuli Classification from Detected P300 for Augmented Brain-Computer Interface: a Deep Learning Approach*, Machine Learning With Applications, Elsevier, 2022.

[J4] J. LEONI, F. Zinnari, E.Villa, M. Tanelli, A. Baldi *Flight Regimes Recognition in Actual Operating Conditions: a Functional Data Analysis Approach*, Engineering Applications of Artificial Intelligence, Elsevier, 2022.

[J3] J. LEONI, M. Tanelli, A. Palman *A New Comprehensive Monitoring and Diagnostic Approach for Early Detection of Mechanical Degradation in Helicopter Transmission Systems*, Expert System With Applications, Elsevier, 2022.

[J2] J. LEONI, M. Tanelli, S.C. Strada, K. Jiang, A. Brusa, A.M. Proverbio, *Brain-Computer Interfaces: A novel automatic stimuli classification algorithm based on ERP data*, Accepted for publication in Expert Systems With Applications, Elsevier, 2021.

[J1] J. LEONI, M. Tanelli, S.C. Strada, T. Berger-Wolf, *Ethogram-based automatic wild animal monitoring through inertial sensors and GPS data*, Accepted for publication in Ecological Informatics, Elsevier, 2020.

Under Submission

[JP2] J. LEONI, V .Breschi, S. Formentin, M. Tanelli, *An Autonomous Physics-Based Mixture of Expert for Optimal Output Reconstruction in Dynamical Systems*, Automatica.

[JP1] J. LEONI, S. Gelmini, G. Panzani, M. Tanelli, M. S. Savaresi, *Optimal Automatic eCall in Powered Two-Wheeler: A Dynamics-Based Approach*, IEEE Transaction on intelligent transportation systems.

International conferences

Published/accepted

[C5] J. LEONI, M. Tanelli, S.C Strada, M. S. Savaresi, *Assessing e-scooters safety and drivability characteristics: a quantitative analysis*, 10th IFAC Symposium: Advances In Automotive Control, 2022.

[C4] J. LEONI, M. Tanelli, S.C. Strada, K. Jiang, A. Brusa, A.M. Proverbio, *Automatic stimuli classification from ERP data for BCI*, 1st IEEE International Conference on Human-Machine Systems, 2020.

[C3] J. LEONI, M.Tanelli, S.C.Strada, T. Berger-Wolf, *Data-Driven Collaborative Intelligent System for Automatic Activities Monitoring of Wild Animals*, 1st IEEE International Conference on Human-Machine Systems, 2020.

[C2] J. LEONI, A. Ciallella, L. Stornaiuolo, M. Santambrogio, D. Sciuto, *EMPhASIS: An EMbedded Public Attention Stress Identification System*, 23rd IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW), 2020.

[C1] J. LEONI, M. Tanelli, S.C Strada, M. S. Savaresi, *Real time passenger mass esstimation for improving e-scooters safety and sustainability*, American Control Conference 2023.

Under Submission

[CS1] J. LEONI, A. Lucchini, M. Tanelli, S. C. Strada, M. S. Savaresi, *Safety-Oriented Methods Based on Road Profile and Driving Style Estimation in eScooter*, IFAC WC 2023.

Patents

Awarded

[F1] 21425025.0 (2021). "Method and system for the anomaly detection of the components of a helicopter's transmission" (METODO E SISTEMA PER RILEVARE ANOMALIE RELATIVE A COMPONENTI DI UN SISTEMA DI TRASMISSIONE DI UN AEROMOBILE,

IN PARTICOLARE UN ELICOTTERO). Applicants: Politecnico di Milano, Leonardo S.p.A. (Inventors: J. Leoni, M. Tanelli, A. Palman, A. Bellazzi, F. Bianchi, L. Bottasso), EU patent, filed on 18/05/2021. Awarded. Patent n. EP 4 091 945 A1.

Request Filed

[FS2] 102021000017558 (2021). "System and method for determining an excessive number of passengers on an eScooter" ("METODO E SISTEMA PER DETERMINARE UN NUMERO ECCESSIVO DI UTENTI A BORDO DI UN MONOPATTINO ELETTRICO "). Applicants: Politecnico di Milano, Edison S.p.a. (Inventors: J. Leoni, A. Lucchini, M. Tanelli, S. Strada, S. Savaresi), Italian patent, filed on 10/12/2021.

[FS1] 21425046.6 (2021). "Method and system for the classification of the flight regimes of an air vehicle, by means of measures acquired during the flight" (METODO E SISTEMA PER RILEVARE REGIMI DI VOLO DI UN AEROMOBILE, SULLA BASE DI MISURE ACQUISITE DURANTE UN VOLO DELL'AEROMOBILE). Applicants: Politecnico di Milano, Leonardo S.p.A. (Inventors: E. Villa, F. Zinnari, J. Leoni, M. Tanelli, D. Mezzanzanica, U. Mariani, A. Baldi), EU patent, filed on 11/10/2021.

References

- Prof. Mara Tanelli, mara.tanelli@polimi.it
- Prof. Tanya Berger-Wolf, berger-wolf.1@osu.edu

Date: 2$^{\text{nd}}$ February, 2023   Sign: _____