

LUCA MAURELLI

DATA ENGINEER | DATA SCIENTIST

UPDATED ON DECEMBER 14, 2023

KEYWORDS: Signal Processing, Prediction & Filtering, Fault Diagnosis & Prognosis, Time Series & Dynamical models, System Identification & Validation, Visualization

SKILLS: Python, Docker, pyarrow, pandas



June 30, 1993 in Milan, Italy
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JOB EXPERIENCE

Data Engineer at Camozzi Digital & Mechatronics

- Application Maintainer of a Digital Monitoring System in Python for Camozzi Group companies:
 - ~2x cost reduction of time-scheduled Azure cloud deployments with server-less computation.
 - ~2x data-lake storage reduction with binary compressed columnar-based and row-based file formats.
 - ~100x speedup of ETL IO-bound pipelines through asyncio support.
 - Optimization of Python code w.r.t CPU/RAM resources by exploiting vectorization computing.
 - Migration computing infrastructure to IaC through Azure ARM and Terraform.
 - Dockerization of ETL pipelines, DevOps CI build and push containers to Azure Container Registry and workflow orchestration with Azure Logic App
 - Researching time and frequency domain signal processing techniques for vibrational data.

Jan 2023 — Present
Brescia
Milano

Ph.D. Student at the Department of Engineering and Applied Sciences

- Theoretical research on the design and estimation of data-driven direct filters in stochastic frameworks.** The proposed approach and the classical solution given by optimal Bayesian filters (KF) is compared in simulation with univariate/multivariate LTI time series and dynamical systems.
- Project **SMART4CPPS**, P1 (University of Bergamo, Camozzi), P4 (University of Bergamo, Cosberg, ABB, CNR).
 - Management activity and writing of technical reports of P1 and P4.**
 - Technical activity of Pilot 1: design of a health monitoring system for solenoid valves:**
 - White-box modeling of the electro-magneto-mechanical dynamics.
 - Cross-references failure modes, mechanisms and effect analysis and related fault diagnostic variables.
 - Ad-hoc signal processing techniques to clean, normalize, and aggregate experimental big data (~ 11M).
 - Physical-informed features extraction from significant points of the transient current profile focused on the detection of motion plunger impediment and the energy used upon the actuation.
 - Development of an online prognostic algorithm to detect the remaining useful life of the system.
 - Technical activity of Pilot 1: design of a health monitoring system for linear cylinders:**
 - Supported selection of sensors for the experimental test bench.
 - Design of the test protocol and calendar scheduling of the acquisition and degradation phases.
 - Acquisition of experimental data and related assessment of the health state of the system.
 - Development of conditional assessment algorithms based on accelerations and current signals using statistical learning routines (Statistical Process Monitoring and Change Point Detection).
 - Technical activity of Pilot 4: zero-defect end-of-line tuning of medium-voltage switches:**
 - Ad-hoc data ingestion phase for the experimental temperature and displacement data.
 - System identification of the coupled grey-box electro-thermal and black-box thermo-mechanical dynamics of the thermal bimetallic component and validation with experimental data.
 - Data augmentation by means of simulating new virtual data. The sampling takes care of the same dependency structure of the experimental data thanks to the statistical Copula distribution.
 - Development of a robust iterative algorithm to tune the end-of-line screw and correct to the desirable trip time by means of an hypothesis on the corrective power bounds.
- Publication of international journal papers and patents** regarding academic and industrial results, see items from [C01] to [P01].

Oct 2019 — Present
University of Bergamo

Research Assistant at the Department of Management, Information and Production Engineering

- Project CRYOABLATION (Dipartimento di Cardiologia, Ospedale di Seriate)
 - Modeling of the temperature dynamics in the cryoablation process for atrial fibrillation therapy.
 - Model selection using in-sample goodness-of-fit & complexity trade-off techniques (FPE-AIC-BIC).
- Project SP@RK-4.0-I.E.S. (Mandelli)
 - Supported design of a predictive maintenance system for the acquisition of experimental acceleration signals the fault diagnosis of rotating components (bearings) in high performance work-centers

May 2018 — Sep 2019
University of Bergamo

Researcher & Software Engineer at Consortium Intellimech (Internship during Master's thesis)

Oct 2017 – Apr 2018

1. Project KNOWLEDGIZE (University of Bergamo, University of Brescia, Cosberg, Elettrocablaggi, Ronzoni)
 - (a) Development of a web platform for corporate knowledge management using Django backend framework, Bootstrap and JavaScript frontend libraries, and Google cloud services.
 - (b) Automation on the creation of "commesse" PDF documents based on user inputs by using LaTeX.
 - (c) Creation of a smart search engine based on similar tags on content using ML algorithms related to natural language processing through the word2vec algorithm of the Gensim Python library.
2. Supported development of a monitoring system software prototype in Python:
 - (a) Creation of a communication publisher-subscriber infrastructure between gateway and industrial machines through MQTT
 - (b) Support to the different communication protocols of the nodes (MQTT, MTCONNECT, UPC-UA, and MODbus) by using Python libraries to parse and encapsulate original messages.

Consortium Intellimech

EDUCATION

Ph.D. in Engineering & Applied Sciences, University of Bergamo, Italy*Learning to filtering: a comparison of data-driven solutions to the filtering design problem*

Sep 29, 2023

Master's degree in Computer Science & Engineering, University of Bergamo, Italy

110L/110

Development of a Knowledge Management Web Platform with an Innovative ML Algorithm based on Tag Searching

Mar 29, 2018

Bachelor's degree in Computer Science & Engineering, University of Bergamo, Italy

105/110

Development of a library for Mobile Robot Trajectory Control

Sep 30, 2015

TEACHING EXPERIENCE

Lecture Assistant of the following **MSc courses** at the University of Bergamo:

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| 1. <i>Controlli Automatici</i> A.Y. 2018/2019 | italian exercises , 20h, Sep – Dec 2018 |
| 2. <i>Controlli Automatici</i> A.Y. 2019/2020 | italian exercises/lectures , 12h, Sep – Dec 2019 |
| 3. <i>Dynamic System Identification</i> A.Y. 2019/2020 | english exercises , 18h, Jan – Jun 2020 |
| 4. <i>Controlli Automatici</i> A.Y. 2020/2021 | italian exercises , 12h, Jan – Jun 2021 |
| 5. <i>Identificazione dei Modelli ed Analisi dei Dati</i> A.Y. 2020/2021 | italian exercises , 12h, Jan – Jun 2021 |
| 6. <i>Controlli Automatici</i> A.Y. 2021/2022 | italian exercises , 12h, Sep – Dec 2021 |
| 7. <i>Identificazione dei Modelli ed Analisi dei Dati</i> A.Y. 2021/2022 | italian lectures , 16h, Jan – Jun 2021 |

Co-advisor of the following **MSc theses** at the University of Bergamo:

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| 1. <i>Sviluppo preliminare di un sistema di health monitoring per un attuatore elettromeccanico</i> | (Davide Palazzini, Alen Preda) Mar 2019 |
| 2. <i>Data-driven health monitoring di attuatori elettromeccanici per automazione industriale</i> | (Davide Presciani, Matteo Gusmini) Dec 2019 |
| 3. <i>Simulatore elettro-termo-meccanico di strisce bimetalliche per interruttori industriali a bassa tensione</i> | (Paolo Pasinetti) Dec 2019 |
| 4. <i>Predizione della vita utile residua di valvole elettropneumatiche usando tecniche di machine learning</i> | (Angela Pomata) Apr 2020 |
| 5. <i>Modellazione, simulazione ed auto-tuning di fine linea per interruttori industriali a bassa tensione</i> | (Simone Zanni) Mar 2021 |
| 6. <i>Progettazione di un algoritmo data driven per la predizione della vita utile residua di valvole elettropneumatiche</i> | (Simone Sudati) Jul 2021 |
| 7. <i>Misure di temperatura per la stima della vita utile residua di valvole industriali</i> | (Michele Brillante) Mar 2022 |

PUBLICATIONS

International conferences

[C01] M. Mazzoleni, M. Scandella, L. MAURELLI, F. Previdi.
Mechatronics applications of condition monitoring using a statistical change detection method
21st IFAC World Congress, Berlin, Germany, July 12-17, 2020

[DOI](#)

[C02] L. MAURELLI, M. Mazzoleni, F. Previdi.
Modeling and simulation of bimetallic strips in industrial circuit breakers
19th IFAC Symposium on System Identification, (Virtual) Padova, Italy, July 14-16, 2021

[DOI](#)**International journals**

[J01] L. MAURELLI, M. Mazzoleni, A. Camisani, F. Previdi.
Physics-informed Remaining Useful Life estimation of cost-effective solenoid valves using significant points of the excitation current
Finished - to be submitted (pending patent)

[J02] L. MAURELLI, M. Mazzoleni, S. Formentin, F. Previdi.
A comparison of indirect and direct filter designs from data for LTI systems: the effect of unknown noise covariance matrices
2023 - Submitted

International patents

[P01] L. MAURELLI, M. Mazzoleni, A. Camisani, F. Previdi.
Camozzi Automation
2022 - Pending

Updated on**Date:** DECEMBER 14, 2023**Signature:****Waiver**

I authorize the treatment of my personal data in compliance with the Italian Legislative Decree 196/2003 and the article GDPR 679/16 - "European regulation on the protection of personal data"