ALEXANDER J. GALLO

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CURRENT POSITION

Postdoctoral researcher *Feb 2021 – present*
Delft Center for Systems and Control, 3mE, Technical University of Delft, the Netherlands

Supervisor Dr. Riccardo M. G. Ferrari
Project "Health-aware wind farm control systems"
Objectives
- Design of control algorithm with dual-objective fatigue mitigation and power generation in wind turbines
- Development of wind-farm-level controllers for lifetime extension

RESEARCH INTERESTS

My research interests include analysis, control, optimization and monitoring of dynamical networks and large-scale interconnected systems, with focus on:

- Distributed and plug-and-play algorithms for *safe and secure control* of large-scale and cyber-physical systems
- Design of control algorithms that are *health aware*, i.e., developed to account for damage accumulation within system components, for uncertain systems

EDUCATION

PhD Control Engineering – Imperial College of London *Oct 2016 – Jan 2021*
Department of Electrical and Electronic Engineering Control and Power Group

Supervisors Prof. Thomas Parisini, Dr. Francesca Boem
Thesis "Plug-and-play Fault Tolerant and Secure Control"
Objectives
- Design of distributed and scalable architectures for detection and isolation of cyber-attacks and faults in large-scale and cyber-physical systems
- Design of control reconfiguration algorithms to accommodate detected anomalies

MEng Electrical Electronic Engineering – Imperial College London *Oct 2012 – Aug 2016*
Department of Electrical and Electronic Engineering

Degree classification Second Class Honors, Upper Class
Final Year Thesis "Plug-and-play Fault Tolerant Control of Electrical Grids"

FURTHER ACADEMIC EXPERIENCE

Teaching experience:

- **Teaching assistant:**
  Fault Diagnosis and Fault Tolerant Control *Apr-Jul 2022, Apr-Jul 2023, Apr-Jul 2024*
  MSc Systems and Control, DCSC, 3mE, TU Delft
- **Student supervision:**
  Co-supervision of two MSc students' theses *Jul 2022 - present*

  DCSC, 3mE, TU Delft, Netherlands

Visiting periods:

- **Hong Kong University** *May 2019*
  Department of Electrical and Electronic Engineering
  Supervisor: Prof. Ron S. Y. Hui
  Objective: Development and experimental validation of cyber-attack detection algorithms applied to networks of Electric Springs, a power electronics device enabling Demand Side Management

- **Ålborg University** *Apr 2019*
  Department of Energy Technology
  Supervisors: Prof. Josep M. Guerrero, Prof. Juan C. Vasquez
  Objective: Experimental validation of cyber-attack detection for DC microgrids

- **École Polytechnique Fédérale de Lausanne** *Oct 2017 , Mar 2018*
  Department of Mechanical Engineering – Laboratoire d'automatique
  Supervisor: Prof. Giancarlo Ferrari-Trecate
  Objective: Development of cyber-attack detection algorithms for DC microgrids

Presentations at international conferences:

A number of authored works have been presented at international conference venues (see Publications [C-3, C-4, C-6, C-7, C-8, C-9, C-11, C-12, C-13])

Invited talks:

- **Technical University Dortmund**, Dortmund, Germany *Oct 2023*
  Title: Secure switching strategies for multiplicative watermarking

- **IMT Lucca**, Lucca, Italy *Oct 2023*
  Title: A distributed cyber-attack detection scheme with application to DC microgrids

- **Imperial College London**, London, United Kingdom *Nov 2022*
  Title: Cryptographic switching functions for multiplicative watermarking in cyber-physical systems

- **KTH Royal Institute of Technology**, Stockholm, Sweden (remote) *Sep 2020*
  Title: Plug-and-play secure control for DC microgrids: A control-theoretic perspective

International funding:

- **Integrated, Value-based and Multi-objective wind farm control powered by Artificial Intelligence (TWAIN)** *HORIZON-RIA* (2022)
  HORIZON-CL5-2022-D3-03 (Sustainable, secure and competitive energy supply)
  Grant awarded, score: 15/15
  Named researcher. Contribution to writing of grant proposal and contribution to ideation of project for two young researchers in the field of wind farm control and secure control

- **Young researcher network for security and resiliency of critical cyber-physical systems (SecRecSy4You)** *HORIZON-TMA-MSCA-DN* (2022)
  HORIZON-MSCA-2022-DN-01
  Grant not awarded, score: 80.2/100
  Named researcher. Contributions to writing of grant proposal and contribution to ideation of project for one young researcher in the field of secure control

- **Plug-and-play fault tolerant control** *EPSRC - PhD Scholarship (2016)*
  Grant awarded
  Recipient of funding for the completion of the PhD.

PROFESSIONAL EXPERIENCE

- **e.quinox** – Chairman (2017–18), Vice-chairman – Head of Technical Development (2015–16), Project Manager Pico-hydroelectric project, Expedition leader – Rwanda (2014–15) *Oct 2013 – Oct 2020*
  Imperial College Union, London, UK
  e.quinox is a a student-led non-profit humanitarian organization creating sustainable models to electrify rural areas in developing countries with cost-effective renewable energy solutions
  Objectives: lead the society and teams in the development of technical and business solutions for rural electrification; organize and lead expeditions to Rwanda for prototype trials and implementation; assess impact of implemented projects on the community

- **Ibis Power** – Electrical Engineering Intern *Apr 2015 – Sep 2015*
  Eindhoven, Netherlands
  Ibis Power is an energy start-up whose aim is to increase the energy generation capabilities of urban areas through innovation in small wind generation
  Objectives: Development of electrical systems (including power generation and monitoring) of principal prototype; research control strategies to maximize power of small-scale wind turbines

JOURNAL AND CONFERENCE PAPERS

[J–1] G. Yang, **AJG**, A. Barboni, R. M. G. Ferrari, A. Serrani, T. Parisini, "On the Output Redundancy of a LTI System: A Geometric Approach with Application to Privacy", *IEEE Transactions on Automatic Control*, Submitted (first review stage), 2024.

[J–2] **AJG**, S. C. Anand, A. Teixeira, R. M. G. Ferrari, "Switching Multiplicative Watermarking Design Against Covert Attacks", *Automatica*, Submitted (second review stage), 2024.

[J–3] J. Gonzalez Silva, T. Keijzer, **AJG**, R. M. G. Ferrari, J-W van Wingerden, "Multi-rate Consensus-based Distributed Control for Large-Scale Wind Farms", *IEEE Transactions on Control System Technology*, Submitted (second review stage), 2024.

[J–4] H. Tabatabei, **AJG**, A. al-Dabbagh, "System Output Reconstruction and Accommodation of False-Data Injection Attacks in Large-Scale Systems", *Automatica*, Submitted (second review stage), 2024.

[J–5] J. Chen, **AJG**, S. Yan, T. Parisini, S. Y. R. Hui, "Cyber-attack detection and countermeasure for distributed electric springs for smart grid applications," *IEEE Access*, vol. 10, pp. 13182–13192, 2022.

[J–6] **AJG**, M. S. Turan, F. Boem, T. Parisini, G. Ferrari-Trecate, "A Distributed Cyber-attack Detection Scheme with Application to DC Microgrids," *IEEE Transactions on Automatic Control*, Special Issue: "Security and Privacy of Distributed Algorithms and Network Systems", vol. 65, no. 9, pp. 3800–3815, 2020.

[J–7] F. Boem, **AJG**, D. M. Raimondo, T. Parisini, "Distributed Fault-Tolerant Control of Large-Scale Systems: an Active Fault Diagnosis Approach," *IEEE Transactions on Control of Network Systems*, vol. 7, no. 1, pp. 288–301, 2020.

[C–1] I. van Straalen, **AJG**, R. M. G. Ferrari, "Attack detection through time fingerprinting: a stochastic event-triggered approach". *63rd Conference on Decision and Control (CDC)*, Submitted, 2024.

[C–2] S. P. Mulders, **AJG**, M. Rotea, "Analysis of Extremum Seeking Control for Wind Turbine Torque Controller Optimization by Aerodynamic and Generator Power Objectives", *American Control Conference*, Accepted, 2024.

[C–3] J. Zhang, **AJG**, R. M. G. Ferrari, "Hybrid design of multiplicative watermarking for defense against malicious parameter identification", *62nd Conference on Decision and Control (CDC)*, pp. 3858–3863, 2023.

[C–4] T. Keijzer, **AJG**, R. M. G. Ferrari, "Hierarchical cyber-attack detection in large-scale interconnected systems", *61st Conference on Decision and Control (CDC)*, pp. 6134–6139, 2022.

[C–5] Z. Feng, **AJG**, Y. Liu, A. Pamososuryo, R. M. G. Ferrari, J. van Wingerden, "An economic model predictive control approach for load mitigation on multiple tower locations of wind turbines," *61st Conference on Decision and Control (CDC)*, pp. 2425–2430, 2022.

[C–6] **AJG**, R. M. G. Ferrari, "Cryptographic switching functions for multiplicative watermarking in cyber-physical systems," *11th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes (SAFEPROCESS)*, vol. 55, n. 6, pp. 414–419, 2022.

[C–7] **AJG**, S. C. Anand, A. M. H. Teixeira, R. M. G. Ferrari, "Design of multiplicative watermarking against covert attacks," *60th Conference on Decision and Control (CDC)*, pp. 4176–4181, 2021.

[C–8] **AJG**, F. Boem, T. Parisini, "Distributed cyber-attack isolation for large-scale interconnected systems," *European Control Conference (ECC)*, pp. 48–53, 2021.

[C–9] **AJG**, A. Barboni, T. Parisini, "On detectability of cyber-attacks for large-scale interconnected systems," *21st IFAC World Congress*, pp. 3521-3526, 2020.

[C–10] A. Barboni, **AJG**, F. Boem, T. Parisini, "A Distributed Approach for the Detection of Covert Attacks in Interconnected Systems with Stochastic Uncertainties," *58th IEEE Conference on Decision and Control (CDC)*, pp. 5623-5628, 2019.

[C–11] **AJG**, M. S. Turan, P. Nahata, F. Boem, T. Parisini, G. Ferrari-Trecate, "Distributed Cyber-Attack Detection in the Secondary Control of DC Microgrids," *European Control Conference (ECC)*, pp. 344-349, 2018.

[C–12] **AJG**, M. S. Turan, F. Boem, G. Ferrari-Trecate, T. Parisini, "Distributed watermarking for secure control of microgrids under replay attacks," *7th IFAC Workshop on Distributed Estimation and Control in Networked Systems (NECSYS)*, vol. 51, n.23, pp. 182–187, 2018.

[C–13] F. Boem, **AJG**, G. Ferrari-Trecate and T. Parisini, "A distributed attack detection method for multi-agent systems governed by consensus-based control," *56th IEEE Conference on Decision and Control (CDC)*, pp. 5961-5966, 2017.

[C–14] D. M. Raimondo, F. Boem, **AJG** and T. Parisini, "A decentralized fault-tolerant control scheme based on Active Fault Diagnosis," *55th IEEE Conference on Decision and Control (CDC)*, pp. 2164-2169, 2016.

UNPUBLISHED RESEARCH

[WP–1] **AJG**, R. M. G. Ferrari, "Health-Aware Control for Wind Turbines: a Lexicographic Model Predictive Control Approach,", To be submitted.

[WP–2] Z. Feng, **AJG**, R. M. G. Ferrari, J-W van Wingerden, "An Economic Model Predictive Control Approach for Turbine Tower Fore-Aft Fatigue Mitigation", In preparation.

[WP–3] T. Desai, **AJG**, R. M. G. Ferrari, "Multi Timescale Battery Modeling: Integrating Physics Insights", In preparation.

[WP–4] S. P. Mullers, **AJG**, M. Rotea, "Extremum Seeking Control of Wind Turbine Torque Control for Power Maximization", In preparation.