# Dr. Mayank Shekhar JHA

Associate Professor (Maitre de Conférences)

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## Research interests:

- Reinforcement Learning for Safe Learning of dynamical systems
- Deep Learning for Health Monitoring and Prognostics of Systems (Model based techniques and Artificial Intelligence)

## Education

- Ph.D. in Automatic Control and Signal Processing, 2015, Ecole Centrale de Lille, France.
- Masters in Automatic Control, 2012, Ecole Centrale de Lille, France.
- Bachelor of Technology (B. Tech) in Mechanical Engineering, National Institute of Technology (NIT) Jalandhar, India.

## Academic Experience

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|---|---|
| 2017-Present | Associate Professor, Control and Reliability of Systems, University of Lorraine. |
| 2017 | Research Associate (Post-doctoral Researcher), Rolls Royce University Technical Centre, University of Sheffield, United-Kingdom. |
| 2016-2017 | Researcher and Teacher, Ecole Centrale de Lille, France. |
| 2016 | Post-Doctoral Researcher, National Institute of Applied Sciences (INSA) Toulouse, France. |

## Research Activities

### Ph.D. Co-Supervision

#### On-going

Soha KANSO, *Contributions to Safe Reinforcement Learning for safety Critical Systems*, **Finance:** CRAN.

Theo RUTCSHK, *Physics Informed Neural Networks based System Identification for Efficient Reinforcement Learning*, Finance: CRAN.

#### Past

Martin HERVE DE BEAULIEU, *Identification and prognosis of state of health of non-linear systems through deep learning. Application to predictive maintenance of business aircraft* in collaboration with **Dassault Aviation**

### Post-Doctoral Co-supervision

Dr. Julien Thuillier, *Health Aware Control Design of Liquid Propulsion Rocket Engine* in collaboration with **Centre National d'Etudes Spatiale CNES** ( The National Centre for Space Studies ).

## Supervision of Master-Research Thesis

**Mohammad Chelouati**, *Control law design based on state of health of system dedicated of reusable thrusters*. See the scientific paper here.
**Soha Kanso**, *Remaining useful life estimation and uncertainty quantification of Liquid Propulsion Rocket Engine Combustion Chamber* . See the scientific paper here.
**George Claudiu ANDREI,** " *Deep Reinforcement Learning for Dynamical Systems*. See the paper here.

## Industrial / International / National Collaborative projects:

**2020-2023**: Scientific co-leader with Prof. Hugues Garnier of a 3-year research collaboration between CRAN and Dassault Aviation starting in 2020
(240,000 Euro).

**2020-2023**: Scientific co-leader of three research contracts between CRAN and CNES Lanceurs (The National Centre of Space Studies France).
Projects titled: Health Aware Control System Design for Reusable Cryogenic Liquid Rocket Engines.
(150,000 Euros )

**2023-2025**: Scientific Leader, Research contract between CRAN and CNES Lanceurs (The National Centre of Space Studies France).
Project titled: Health Aware Control System Design based on Machine learning for reusable Cryogenic Liquid Rocket Engines) –
(100,000 Euros)

**2023-2027**: French National Research Agency (ANR) funded project , *Adaptive and resilient self-organization of heterogeneous robot fleets by collective emergence for a mission" (SOS*),
Head the working package: "Scientific dissemination" and participation"
Participant: Ph.D. Thesis work on the theme of reinforcement learning for land and air robots, in collaboration with the University of Lille and Lynxdron.
(500,000 Euros total funding)

## Invited Talks

- **June 2023:** Invitation by "NASA Ames Research Center, Center of Excellence in Prognostics" from June 5, 2023 to June 8, 2023 for collaborative research on "Safe Reinforcement Learning and Prognostics".
- **November 2022**: **Invited Lecture** at NASA Ames Research Centers , Prognostics Centre of Excellence (PCOE lecture series), on the topic '*Safe Reinforcement Learning and Prognostics*'
- **Décember 2020** : **Invited Talk** - Fédération Charles Hermite – Journée Intelligence Artificielle et Automatique : quelles interactions ? – Title « *Deep learning and prognostics of dynamical systems under degradation*
- **February 2021 : Invited Special Session speaker** - International Conference on Electronics, Information, and Communication (ICEIC) 2021, Republic of Korea, "Prognostics of Systems Under Degradation".
- **February 2020 : Invited talk** -- Korea Institute of Science and Technology Europe -- "*Prognostics and Health Monitoring using Bayesian Estimation and Deep Learning*".

## Organizational activities:

- Co-organizer of Invited session titled "*Intelligent data-driven fault diagnosis, prognostics and health aware control*" at IFAC World Congress 2023, (IFAC WC 2023), Yokohama, Japan.
- Co-Organiser of ***Health Aware Control Design in Aerospace Domain Seminar, Polytech Nancy*** **with CNES, France, 17th November 2022.**
- IPC Chair, 16th European Workshop on Advanced Control and Diagnosis (ACD 2022), Nancy, France.

- Session chair at Prognostics and Health Management Society Conference Europe, Utretch, Netherlands, 2017
- Associate Editor for 28th Mediterranean Conference on Control and Automation (MED'2020)
- Workshop and Tutorials Chair for 28th Mediterranean Conference on Control and Automation (MED'2020)
- Publicity chair for 5th International Conference on Control and Fault-Tolerant Systems (SySTOL), 2021

## Journal Publications

Martin Hervé de Beaulieu, **Mayank Shekhar Jha,** Hugues Garnier, Farid Cerbah, End-to-end Remaining Useful Life Prediction based on Physics Informed Data Augmentation, **phase #3 Revision, Reliability Engineering and System Safety, Elsevier.**

**JHA, Mayank Shekhar** and Bahare Kiumarsi. "Off-Policy Safe Reinforcement Learning for Nonlinear Discrete-Time Systems." **Phase #2 Revision**, *Neurocomputing*, *Available at SSRN 4559729*.

Kanso, S., **Jha, M. S.**, & Theilliol, D. (2024). Degradation Tolerant Optimal Control Design for Stochastic Linear Systems. *Int. J. Appl. Math. Comput. Sci*, *34*(1), 5-14.

Thuillier, J., **Jha, M. S.**, Le Martelot, S., & Theilliol, D. (2024). Prognostics Aware Control Design for Extended Remaining Useful Life: Application to Liquid Propellant Reusable Rocket Engine. *International Journal of Prognostics and Health Management*, *15*(1).

Kanso, S., **Jha, M. S.,** & Theilliol, D. (2024). Off-policy model-based end-to-end safe reinforcement learning. *International Journal of Robust and Nonlinear Control*, *34*(4), 2806-2831.

**Jha, M. S.,** Theilliol, D., & Weber, P. (2023). Model-free optimal tracking over finite horizon using adaptive dynamic programming. *Optimal Control Applications and Methods*, *44*(6), 3114-3138.

Kumar, D., Kalra, S., & **Jha, M. S.** (2022). A concise review on degradation of gun barrels and its health monitoring techniques. *Engineering Failure Analysis*, *142*, 106791.

Suh, S., Jang, J., Won, S., **Jha, M. S.**, & Lee, Y. O. (2020). Supervised Health Stage Prediction Using Convolutional Neural Networks for Bearing Wear. Sensors, 20(20), 5846.

**Jha, M. S.,** Dauphin-Tanguy, G., & Ould-Bouamama, B. (2018). Robust fault detection with Interval Valued Uncertainties in Bond Graph Framework. ***Control Engineering Practice***, **Elsevier,** *71*, 61-78.

**M. S Jha**, Nizar Chatti, Philippe Declerck, Robust Fault Detection in Bond Graph Framework Using Interval Analysis and Fourier Motzkin Elimination Technique, **Mechanical Systems and Signal Processing**, **Elsevier**, Volume 93, 1 September 2017, Pages 494-514.

**M. S Jha**, G. Dauphin-Tanguy, B. Ould Bouamama, Particle Filter Based Hybrid Prognostics for Health Monitoring of Uncertain Systems in Bond Graph Framework, **Mechanical Systems and Signal Processing, Elsevier**, Volume 75, 15 June 2016, Pages 301-329, ISSN 0888-3270.

**M. S Jha**, M. Bressel, G. Dauphin-Tanguy, B. Ould Bouamama Particle filter based hybrid prognostics of proton exchange membrane fuel cell in bond graph framework. **Computers & Chemical Engineering, Elsevier,** 2016;95:216-30.

**M. S Jha**, M. Bressel, B. Ould-Bouamama, M. Hilairet and D. Hissel, Prognostics of PEM Fuel Cell Under Constant Load, **International Journal of Renewable Energy Research** (IJRER). 2016;6:644-57.

***Book Chapter***

**M. S Jha**, G. Dauphin-Tanguy, B. Ould Bouamama, Particle Filter Based Integrated Health Monitoring in Bond Graph Framework, Chapitre dans Bond Graphs for Modelling, Control and Fault Diagnosis of Engineering Systems, Borutzky W, editor, **Springer International Publishing**; 2017. p. 233-70.

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*International peer-reviewed conferences*

**Jha, M. S.,** Kiumarsi, B., & Theilliol, D. (2024), Safe Reinforcement Learning based on Off-policy approach for Nonlinear Discrete-Time Systems, *to appear,* American Control Conference, Toronto, Canada.

**Mayank Shekhar Jha,** Hugues Garnier, Didier Theilliol,Redundancy-Aware Physics Informed Neural Networks (RPINNs) based Learning of Nonlinear Algebraic Systems with Non-Measurable States, 62nd IEEE Conference on Decision and Control, Dec. 13-15, 2023, Singapore.

Soha Kanso, **Mayank Shekhar Jha,** Didier Theilliol, Degradation tolerant optimal control design for linear discrete systems, 15th International Conference on Diagnostics of Processes and Systems.

Soha Kanso, **Mayank S. Jha,** Marco Galeotta, and Didier Theilliol. " Remaining Useful Life Prediction with Uncertainty Quantification of Liquid Propulsion Rocket Engine Combustion Chamber" *Accepté*, In 11th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes - SAFEPROCESS 2022 Pafos, Cyprus.

Martin Herve De Beaulieu, **Mayank Shekhar JHA**, Hugues Garnier, Farid Cerbah, "Unsupervised Remaining Useful Life Prediction through Long Range Health Index Estimation based on Encoders-Decoders", *Accepté*, In 11th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes - SAFEPROCESS 2022 Pafos, Cyprus.

Chelouati, Mohammed, **Mayank S. Jha,** Marco Galeotta, and Didier Theilliol. "Remaining Useful Life Prediction for Liquid Propulsion Rocket Engine Combustion Chamber." In 2021 5th International Conference on Control and Fault-Tolerant Systems (SysTol), pp. 225-230. IEEE, 2021

**Jha, M. S.,** Weber, P., Theilliol, D., Ponsart, J. C., & Maquin, D. (2019, July). A Reinforcement Learning Approach to Health Aware Control Strategy. In 2019 27th Mediterranean Conference on Control and Automation (MED) (pp. 171-176). IEEE.

**M. S. Jha**, D. Theilliol, G. Biswas, and P. Weber, "Approximate Q-learning approach for Health Aware Control Design," in 4th International Conference on Control and Fault-Tolerant Systems (SYSTOL), 18-20 September 2019, Casablanca, Morocco, 2019.

Hai Canh VU, Phuc DO, **Mayank Shekhar JHA**, Didier THEILLIOL, Flavien PEYSSON, A comparative study of particle filters for prognostics implementation in industry à 4th european conference of the prognostics and health management 2018, Juillet 3-6, Utrecht, Pays-Bas, 2018.

Liu, B., Do Van, P., Iung, B., Xie, M., Peysson, F. & **Jha, M. S.** (2018, July). A study on the use of discrete event data for prognostics and health management: discovery of association rules. In Proceedings of the 4th European conference of the PHM society

M. Bressel, **M. S. Jha**, B. Ould-Bouamama, M. Hilairet and D. Hissel, Bond Graph for modelling and diagnostics of Proton Exchange Membrane Fuel Cell, International Conference on Bond Graph Modeling and Simulation, Montreal, Canada, 2016.

**M. S. Jha**, M. Bressel, B. Ould-Bouamama, G. Dauphin-Tanguy, M. Hilairet and D. Hissel, Particle FilterBased Prognostics of PEM Fuel Cell in Bond Graph Framework,Conférence Internationale des Energies Renouvelables (CIER-2015), Sousse - Tunisie, Décembre 21-23, 2015.

**M.S. Jha**, G. Dauphin-Tanguy, B. Ould Bouamama, New Concept of Junction Activity in a Bond Graph Model: Application for Fault Identification, International Conference on Bond Graph Modeling and Simulation., Monterey, California, USA, 2014.

**M. S. Jha**, G. Dauphin-Tanguy, B. Ould Bouamama, Integrated Diagnosis and Prognosis of Uncertain Systems: A Bond Graph Approach in: Second European Conference of the PHM Society 2014 European Conference of the PHM Society 2014 Proceedings, Nantes, France, 2014, pp. 391-400.

**M. S. Jha**, G. Dauphin-Tanguy, B. Ould Bouamama, Robust FDI Based On LFT BG And Relative Activity At Junction, European Control Conference (ECC), 2014, pp. 938-943.

**Jha, M.S.**, Dauphin-Tanguy, G, Ould Bouamama, B., Interval Approach for Robust Fault Diagnosis, International Conference on Integrated Modeling and Analysis in Applied Control and Automation, 2012, Volume 1, 2012, Pages 239-246.

A. Vaz, **M.S. JHA**, R. Seth, A. Saxena, Design and development of an instrument for measurement of biting force in human beings, ASME 2012 11th Biennial Conference on Engineering Systems Design and Analysis, ESDA 2012 , Volume 4, 2012, Pages 227-232.

A. Vaz, **M.S. JHA**, K. Mahajan, A. Parashar, Experimental study of switching behaviour in the transmission of tension to the joints of the finger, ASME 2012 11th Biennial Conference on Engineering Systems Design and Analysis, ASME ESDA 2012 , Volume 3, 2012, Pages 321-327.

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