***Research theme title*:**

Model-based and data-driven learning and control techniques for increasing reliability and safety of an autonomous system in uncertain and hazardous environment

***Description*:**

The proposed PhD program will involve research activities focused on data-driven methods for building internal models and integrating self-diagnostic capabilities within autonomous robots operating in hostile environments. The investigation will explore the capabilities of data-driven methods to construct accurate internal models. By processing sensor data and building internal models, the robot's perception of internal and environmental states will improve decision-making capabilities and autonomy. Model-based system-theoretical tools and adaptive control techniques will be investigated to interact with the environment and move around. Specific challenges in hostile environments could be addressed, such as energy optimization, obstacle avoidance, and decision-making under uncertainty. Self-diagnostic and self-healing algorithms and mechanisms will be studied to detect and address mechanical or electrical faults promptly. The collected diagnostic data will improve system design and maintenance strategies. In summary, this PhD program aims to enhance understanding, reliability, and performance, enabling efficient operations and minimizing risks in challenging environments by leveraging a data-driven approach and integrating self-diagnostic mechanisms.

Related Works:

Model-based vs data-driven adaptive control: an overview. Benosman, M. (2018). International Journal of Adaptive Control and Signal Processing, 32(5), 753-776.

An integrated model-based and data-driven gap metric method for fault detection and isolation. Jin, H., Zuo, Z., Wang, Y., Cui, L., & Li, L. (2021). IEEE Transactions on Cybernetics, 52(12), 12687-12697.

From model, signal to knowledge: A data-driven perspective of fault detection and diagnosis. Dai, X., & Gao, Z. (2013). IEEE Transactions on Industrial Informatics, 9(4), 2226-2238.

Zhang B, Yu W, Jia Y, Huang J, Yang D, Zhong Z. Predicting vehicle trajectory via combination of model-based and data-driven methods using Kalman filter. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 2023;0(0). doi:10.1177/09544070231161846

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Type of scholarship:

DM 118/2023 – Project on PNRR (Italy's Recovery and Resilience Plan)