Finanziato dall'Unione europea NextGenerationEU

BORSA N. 1

DAUSY

Borsa di Ateneo
Tematica: "*Decision and Control Techniques for Intelligent Diagnostic and Surgery Using Digital Twins*"

Research theme title:

Decision and Control Techniques for Intelligent Diagnostic and Surgery Using Digital Twins

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Curriculum of DAUSY:

C3 AS for Monitoring and Security

Hosting University/Research Centre

Polytechnic of Bari, Italy

Department:

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Description:

Digital twins (DTs) are virtual replicas of physical entities that go beyond a still image and encompass the dynamic functionality of the real-life object. Widely used in industries such as construction and aviation, the DT concept is being recently applied in the healthcare industry with the aim of creating molecular and phenotypic copies of human beings that can allow, for instance, to trial different therapies to elucidate the most efficacious treatment for the real-life patient. DTs can be also employed to improve diagnosis and treatment using the integration and clinical exploitation of complex data. Applied to medicine and public health, DTs enable learning and discovering new knowledge, new hypothesis generation, and testing. They are poised to play a key role in formulating highly personalized treatments and interventions in the future.
Against this background, this project will develop decision and control tools that address the emerging need of intelligent supporting systems for the diagnostics and surgery of severe diseases such as tumors. On the one hand, the DT of a patient will be created with the aim of offering to the medical team a preview of the intervention area and access routes, with a detailed and interactively editable view. On the other hand, a simulator (based on machine learning and optimization techniques) will be developed so that the surgery can be planned in multidisciplinary team meetings, practiced and optimized beforehand, and referenced during the operation to verify anatomy and avoid inadvertent damage to structures. The real-time model of the patient will also give rise to clinical trials where new instruments, techniques or therapies are first tried on the DT, thus minimizing risks to the patient.

Specific Information:

Applicants must hold a master's degree, preferably in Engineering, with a good background in relevant areas of interest (i.e., optimization, control, and deep learning). Solid mathematical and coding skills are encouraged. Proficiency in both spoken and written English is required. The candidate should be highly motivated and interested in undertaking innovative and challenging research activities involving both theoretical analysis and experimental validation.

References:

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[8]. Bevilacqua, V., Pietroleonardo, N., Triggiani, V., Brunetti, A., Di Palma, A. M., Rossini, M., Gesualdo, L. An innovative neural network framework to classify blood vessels and tubules based on Haralick features evaluated in histological images of kidney biopsy. Neurocomputing, 228, 143-153 (2017). Doi: 10.1016/j.neucom.2016.09.091
[9]. Bevilacqua, V., Brunetti, A., Guerriero, A., Trotta, G. F., Telegrafo, M., & Moschetta, M. A performance comparison between shallow and deeper neural networks supervised classification of tomosynthesis breast lesions images. Cognitive Systems Research, 53, 3-19 (2019). Doi: 10.1016/j.cogsys.2018.04.011

Finanziato dall'Unione europea NextGenerationEU

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Type of scholarship:

Project funded by the Hosting Institution

Study and research period outside the Hosting Institution:

Eventual study and research period abroad:

- period length: 6 months;
- Hosting institution:
  - University of Edinburgh
  - School of Engineering – Bioengineering Research Institute
  - https://www.eng.ed.ac.uk/research/institutes/ibioe/about - https://www.eng.ed.ac.uk/about/people/dr-filippo-menolascina