# BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

## Ammin/DIMEAS - Integrating physics-based and data-driven modelling approaches for cardiovascular disease diagnosis, prediction, and treatment optimization

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| **Funded By** | Dipartimento DIMEAS<br>Politecnico di TORINO [P.iva/CF:00518460019] |
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| **Contact** | |
| **Context of the research activity** | Despite advances in medical science and healthcare, cardiovascular diseases prevalence continues to rise, highlighting the need for innovative approaches in diagnosis, personalized treatment, and effective management. Integrating medical imaging and computer simulations enable the creation of patient-specific models, which are emerging as effective tools for understanding cardiovascular pathophysiology, optimizing medical device design, and supporting clinical decision-making. |
| **Objectives** | The research objectives of this doctoral program are interconnected and include the following:<br>• To develop and validate integrated physics-based and data-driven computational approaches for supporting the detection, diagnosis, and personalized treatment of cardiovascular diseases.<br>• To advance integrated computational methods for facilitating the design, optimization, and characterization of cardiovascular devices, including novel vascular stents and transcatheter valves, and their associated treatment procedures.<br>• To identify biomechanical factors influencing the onset and progression of cardiovascular diseases, as well as the post-procedural outcomes of cardiovascular devices, while evaluating their complex interplay with other factors such as demographic, biological, and procedural variables.<br>• To lead multidisciplinary collaborative efforts that promote the clinical adoption of computational technologies and translate engineering-based findings and developments into clinical practice.<br>These objectives can be achieved by integrating clinical measurements and medical imaging analysis (including intravascular imaging) with computational modeling and simulation techniques (including computational solid mechanics, computational fluid dynamics, fluid-structure interaction analysis, and agent-based modeling) as well as artificial intelligence. The integration of these methods is expected to advance computational biomechanics, providing engineers, vascular biologists, and cardiologists with |

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| | powerful non-invasive diagnostic, predictive, and optimization tools for better understanding and treating cardiovascular diseases. |

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| **Skills and competencies for the development of the activity** | Cardiovascular solid and fluid mechanics; Transport phenomena; Medical image processing; Computational solid and fluid mechanics; Machine learning; Deep learning; Computer programming. |