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Bringing geometric methods to robot learning, optimization and control

IROS 2020 Workshop

Talk title:
Complex Robotic Systems: Modeling, Control, and Planning using Dual Quaternion Algebra

Speaker:
Bruno Adorno
https://adorno.eng.ufmg.br/

Abstract:
According to the United Nations, more than two billion elderlies will live in the world by 2050, whereas there will be only four working-age people per elderly. While population aging is increasing, the proportional workforce is decreasing, hence motivating the use of robotic assistants that will work closely with humans.As a result of more than fifty years of research, we are seeing increasingly more robots working in human environments and/or alongside humans, and we expect that they will actively interact with people and other robots in complex tasks both in the homes and factories of the future. However, many theoretical and practical challenges have to be solved to guarantee the reliability and proper functionality of such complex systems. To manage that complexity, robot modeling, control, planning, and high-level task description are usually treated separately in different layers. Although that strategy may provide useful abstractions and make the complexity more manageable, it invariably leads to the usage of different mathematical representations and techniques that demand intermediate mappings between those layers, which results in atheoretical patchwork that usually introduces unnecessary singularities and discontinuities in the complete robotic system. Furthermore, due to those different layers, local guarantees (i.e., the ones in specific layers)may not hold when all layers are integrated. In this talk, I will present our efforts to unify robot modeling,control, and planning by using a single mathematical language, namely dual quaternion algebra, and the application of our techniques to surgical robots, mobile manipulators, humanoids, and cooperative robotic systems.