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Reference Dynamics – Based control strategy for constrained systems

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Abstract

The paper topic relates to modeling for control applications and control of constrained mechanical systems. It presents a unified control architecture designed for motion planning, tracking, following or both tracking and following, for constrained systems, specifically nonholonomic. It provides a systematic and unified approach for planning desired motions, e.g. tasks referred to as programs required to be performed by systems, and their tracking provided they may be specified by equations of constraints and error functions, either algebraic or differential. The strategy developed based on this control architecture is referred to as a model reference tracking control strategy for programmed motion. It is based on reference dynamics and one dynamic control model for constrained systems, which is not sensitive to the task-based constraint kind and order. The reference dynamics is derived by the generalized programmed motion equations (GPME) method, which enables merging all tasks requested for the controlled system into one constrained dynamics. The preplanned motion, which is a reference motion in control, may be executed by control algorithms dedicated to nonlinear systems and even these dedicated to holonomic systems.

The theoretical framework is illustrated by the examples of motion tracking and both tracking and following for constraint systems, where the constraints are task-based and for which the classical control oriented dynamics modeling and control methods may not work.

Biography

Elżbieta Jarzębowska is currently a professor at the Institute of Aeronautics and Applied Mechanics at the Power and Aeronautical Engineering Department, Warsaw University of Technology, Warsaw, Poland. She received the B.S., M.S., Ph.D., and D.Sc. degrees in mechanical engineering, control and mechanics of constrained systems, from the Warsaw University of Technology.

Her fields of research expertise and teaching include dynamics modeling and analysis of multibody systems, nonlinear control of multibody systems including nonholonomic, under actuated, UAV, and mobile robotic systems, and geometric control theory.

Prof. Jarzębowska was involved in research projects for Automotive Research Centre and Engineering Research Centre for Reconfigurable Machining Systems at the University of Michigan, Ann Arbor, MI. Also, she gained valuable experience when worked for Ford Motor Company Research Laboratories, Dearborn, MI.

She is the author and coauthor of five handbooks and a monograph in mechanics and control, and more than 100 publications.

She is a member of ASME, IEEE, GAMM, IFToMM Technical Committee of Mechatronics, and International Society for Advanced Research – Italy based society and a scientific publisher.