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Automated Articulated Ground Vehicles

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Abstract Articulated Ground Vehicles (ArGV) are very important and interesting dynamical systems from both the theoretical and application point of view. They include such multi-body structures like N-trailer vehicles (tractor-trailers), multi-steering articulated vehicles, articulated-steer vehicles (e.g. LHD loaders), large-capacity vehicles (LCV) and road trains, (multi-) articulated buses, aircraft-towing systems, special-purpose articulated vehicles for agriculture and mining, etc.. The purpose of this Open Invited Track is to address theoretical, computational, and application-oriented problems related to automation of ArGV motion in the broad context of modeling, motion planning, and control design relative to this type of dynamical systems.

Description and thematic scope Articulated Ground Vehicles (ArGV) are very important and interesting dynamical systems from both the theoretical and application point of view. One may include to this set the N-trailer vehicles (tractor-trailers), multi-steering articulated vehicles, articulated-steer vehicles (e.g. LHD loaders), large-capacity vehicles (LCV) and road trains, (multi-) articulated buses, aircraft-towing systems, special-purpose articulated vehicles for agriculture and mining, etc.. Substantial theoretical interest in the area of ArGV comes from the fact that nonlinear models of articulated wheeled vehicles can be characterized by various specific phenomena and properties like in-joints instability, nonminimum-phasiness, underactuation, nonholonomy, or lack of differential flatness, which make the problems of control design and motion planning especially difficult for this kind of systems. In the context of applications, one can find ArGV in many various areas of today industry, agriculture as well as public and freight transportation. The nowadays trends indicate even increasing usage of ArGV due to environmental and economic reasons. The presence of inherent practical limitations concerning uncertainties of vehicle models, limited availability of robust sensory systems for state measuring and vehicle localization, together with hard state constraints imposed by motion safety arguments and construction limitations of ArGV lead to additional difficulties which must be addressed to successfully use them as the automated/autonomous systems. In the times of intensive development of intelligent and autonomous cars (single-body vehicles), and because of a high difficulty of maneuvering with ArGV by human drivers, there is a growing need to develop the corresponding control and motion strategies also for ArGV (multi-body vehicles) which are safe, efficient, and scalable to enable in the near future a sufficiently high-level of automatization (or even autonomization) for this kind of complex systems. Although some companies have recently proposed prototypes of tractor-trailer like autonomous ArGV (e.g., the Volvo's autonomous truck concept Vera, the Case IH's autonomous agricultural tractor-trailer, or the Terberg's AutoTUG terminal tractor), due to high complexity of multi-body structures the numerous research and engineering issues in the context of automation still remain open for ArGV. This Open Invited Track aims at addressing any aspects related to automation of ArGV motion by considering the new or well-known but not successfully solved yet theoretical, computational, and application-oriented problems in the broad area of modeling, motion planning, and control of ArGV for various motion/control tasks under practical conditions. Examples of the detailed topics falling into the Track's range of interest include (but are not limited to):

- ✓ kinematics, kinetics, parametric identification, and new structural properties of ArGV
- ✓ feedback control design for various motion tasks of ArGV (path-following, trajectory-tracking, docking, lining-up,...)
- ✓ planning and computing reference signals for ArGV
- ✓ motion strategies addressing state- and input-constraints of ArGV
- ✓ anti-rollover, anti-jackknife, off-tracking-reduction, etc. control strategies for ArGV
- ✓ control strategies for optimization of energy usage in ArGV
- ✓ robust motion strategies for ArGV in the presence of skid-slip perturbations
- ✓ design of advanced driver assistance systems (ADAS) for control and guidance of ArGV
- ✓ new sensory and robust localization technologies for automated ArGV
- ✓ motion and control strategies for ArGV with limited sensing/measurement capabilities
- ✓ application issues of automated ArGV in the industry, agriculture, and transportation areas.

It is expected that this Open Invited Track will gather together researchers and practitioners currently working in the field to share their knowledge, exchange experiences, and potentially join their efforts in this fascinating and urgent area of research and development.

IFAC Technical Committees Open Invited Track can be located on an intersection of two main research and technological areas of intelligent/automated vehicles and mobile robotics related to the scope of two IFAC Technical Committees: TRANSPORTATION AND VEHICLE SYSTEMS and MECHATRONICS, ROBOTICS AND COMPONENTS.

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