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SMART WHEEL-BASED STAIR-CLIMBING ROBOT

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Summary: Smart aspects in development of a wheel-based robot which is capable to climb stairs autonomously are presented. Autonomy connotes the ability to climb stairs without any mechanical contact to environment except ground contact with wheels. A comparison of wheel-based to other known locomotion systems is given. Advantages of wheel-based systems are emphasized. The presented Stair Climber (SC) robot uses a rotated chassis whereat the number of contacts between wheel pairs and ground alternates between one and two. As consequence, the SC experiences discontinuous dynamics due to wheel-to-ground repeating contact activations and deactivations. Moreover, the continuous dynamics characteristics of the SC distinguish in different contact situations. Consequently, the SC model is of hybrid dynamics. Methodic aspects of the research and development of the SC are given in overview focusing on modeling and control design. The control design contains a strategy for stair-climbing which is realized as a sequence of different motion types. These motion types include motion along equilibrium points as well as motion in between equilibrium points crossing discrete state borders. Since the system is of nonlinear dynamics, feedback linearization techniques are applied. Specific for one of the SC states is underactuation which has to be considered in control design. Furthermore, one state transition is realized within the virtual constraints framework resulting in smooth wheel-to-ground contact activations. Typical results cover the presented SC. Development perspectives of existing SC are given.