DESIGNING AGILE MOBILE ROBOTS FOR INDUSTRIAL APPLICATIONS

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Abstract: A mobile robot can be considered as agile if it can evolve in its environment and perform tasks with better performances than other robots. An agile robot can evolve in a wider environment, cross obstacles that used to be uncrossable, move at higher speed with better stability or use less energy than classical robots. Mobile robots become commonly used for industrial transport of parts, materials or even people. They are also used for outdoors applications such as civil engineering, agriculture, security and emergency rescuing.

Kinematic synthesis of agile robots requires to identify which performance factor to improve and with which additional motion. In this work, four examples of agile robots are presented that illustrate the design method, each one provided with a short review of existing classical robots for performing similar tasks.

The first robot is a skid-steering vehicle, that do not include a steering device, which is useful to simplify heavy vehicles with a great number of wheels. Our 6x6 Kokoon platform takes advantage 6 trailing arm suspensions without steering wheels to improve its robustness for transport on irregular grounds. However, the great energy required to steer on adherent grounds such as macadam led us to develop an innovative dual-state reconfigurable suspension capable to save energy during steering.

The OpenWHEEL i3R robot is an agile robot that combines the efficiency and simplicity of a four-wheel vehicle with the obstacle-crossing capacity of a legged vehicle, thanks to its articulated frame. Stable obstacle-crossing is obtained with a 19-stage crossing-process. Such a robot can allow stable and slow transport in cluttered or unstructured environment, without dedicated alleys for robotic conveyors.

The MiniFAST terrestrial drone is aimed at fast locomotion at 10-30 m/s on irregular grounds. It has a 4x4 platform equipped with innovative suspensions that allow four motions of the wheel with respect to the frame : the classical propulsion, steering and vertical suspension motions but also an original longitudinal motion to damp violent shocks of the vehicle against high obstacles. The suspension relies on a spatial parallel mechanism with five limbs, that was patented.

Finally, the Pobot robot was designed for safe climbing of conical poles. Its original patented concept of rolling self-locking allows it to stay on top of the pole without energy consumption. Passive retaining arms self-adapt their retaining force and allow to pass tangential obstacles. This agile robot is particularly suitable for climbing tasks on vertical structures.

Key words: Agile mobile robots, Skid steering, Obstacle crossing, Vehicle suspension, Pole climbing, Kinematic synthesis.