

Two-Wheeled Unstable Transporter

Autonomous real-time control of a mobile vehicle

Two-Wheeled Unstable Transporter is an example of quite a complex control system. It is obliged simultaneously meet two control algorithms. The first one is a master regulator. It is responsible to maintain the transporter in the upper unstable equilibrium point. The second one has to follow the predetermined trajectory of the vehicle. Linear quadratic regulators in various forms serve in both control algorithms. To achieve the stabilization goal we need to measure the angle of the transporter pin deviation from the vertical position. This angle is measured due to the combined sensors on the single ADIS device containing an accelerometer and a gyroscope. To stabilize the inherently unstable system it is required the measurement of the deviation of the system from the vertical and the measurement of angles of rotation of both wheels on an ongoing basis. The rotation angles are obtained from the encoders.

To actuate the transporter the wheels are driven by the PWM signals generated by a notebook or a PC controllers. In principle, systems manufactured by INTECO are based on the same educational approach. At the beginning, control algorithms are built as models, at MATLAB/Simulink or other platforms. Fig.1. The figure on the left shows a simulation trajectory of the transporter model.

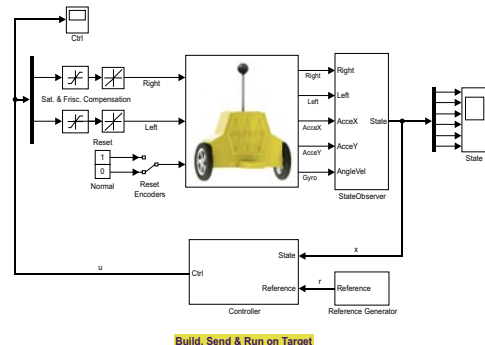
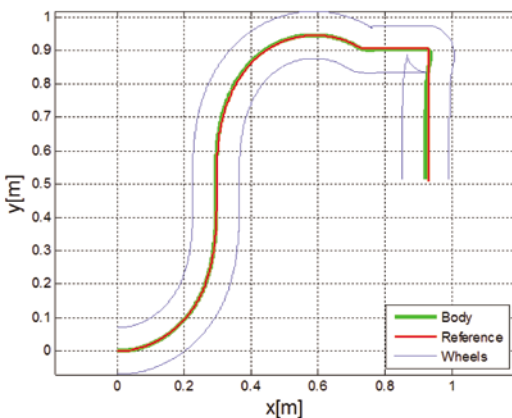
Finally, the simulated controller is transferred to the real-time system. Fig.2. The figure on the right illustrates the real real-time driver. The same controller is applied that has been previously simulated. The special "Built Send & Run on Target" button activates the real-time control procedure. To control in real-time several steps are required: the FPGA of the board RT-DAC/PCI-D has to be reconfigured to communicate with the ADIS device to conform its SPI protocol; the interface has to be built in a form of S-function to get access to measurements and control signals.



Hardware:

- Autonomous unit, wireless communication with the command input computer and trajectory visualization output computer, battery powered
- 2 DC motors equipped with gears PWM controlled

Dimensions: 440x350x600 mm



Build, Send & Run on Target