ELECTIVE IN ROBOTICS 2012/13
Short project in Module "Locomotion and Haptic Interfaces"

Re-centering motion controller for the CyberCarpet considering also walker orientation

This project aims at the evaluation of an alternative feedback law for re-centering the walking user on the CyberCarpet platform, considering also his/her orientation. It is assumed that both the position as well as the orientation of the walker on the platform is available from the overhead visual system.

Two operative conditions should be considered:

a) The human user is standing still, and we wish to maneuver the platform so as to bring the user at the platform center with a given desired absolute orientation. In this case, the controller should tackle a regulation task of the (x,y,θ_w) configuration variables using the two commands (v,ω), facing thus in full the nonholonomy of the system. Ideas for the control design can be drawn from the course on "Autonomous and Mobile Robotics".

b) The human intention is to walk along a square path (with trapezoidal speed profile along each side, with maximum speed of 1 m/s). Re-centering occurs in this case also with the smooth controller (including the walker intentional velocity disturbance observer) in [1], but the availability of information on the walker body orientation should be used in a modified control design so as to improve the transient behavior. Also, the simpler controller for (x.y) regulation of [2] could be used for the feedback part.

A first-order kinematic model of the walker/platform should be used, and the circular platform is assumed to have 3 m of diameter. Test the control performance with Matlab/Simulink simulations (with some 2D visualization of the walker motion on the platform, and plots of the relevant variables and commands).

Supporting material:

[1] A. De Luca, R. Mattone, P. Robuffo Giordano, H. Ulbrich, M. Schwaiger, M. Van den Bergh, E. Koller-Meier, and L. Van Gool, "Motion Control of the CyberCarpet Platform," *IEEE Trans. on Control Systems Technology*, on-line in IEEE Xplore from 6 Feb 2012.

[2] A. De Luca, G. Oriolo, "Local incremental planning for nonholonomic mobile robots," *1994 IEEE Int. Conf. on Robotics and Automation*, pp. 104-110, 1994.

ADL, November 23, 2012