L. Bregant, P. Gallina, P. Pascutto, “Force control systems for robot-assisted rehabilitation”, ROBTEP 2004, Vyšné Ružbachy, 19. - 21. 5. 2004

Abstract:
In the last decades, many robots for orthopaedic rehabilitation and neuro-rehabilitation have been developed. Unlike traditional industrial robots, rehabilitation robots require effective controllers in order to prevent the patient from being hurt. Robots are designed to mimic the beneficial manipulation of the therapist as well as to perform accurate diagnoses. Unfortunately, traditional therapy programs rely heavily on the experience of the therapist which is difficult to translate in a robotic algorithm. Among others, limiting the interaction force between patient and robot end-effector is a key task.
This paper presents a new concept of force controller suited for robot-assisted rehabilitation. The controller, which is referred to as delayed reference control (DRC), belongs to the category of non-time based controllers. This controller makes the robot follow a given pre-planned path, preventing the interaction force from exceeding dangerous values. In fact, the desired input reference is described as a function of the time and a variable which plays the role of a time delay: x_d (t-T). Delay is properly calculated on-line according to the measured force signals in such a way to improve the patient/robot interaction. The DRC consists in a outer force feedback loop around an inner position feedback loop. The paper reports on the effectiveness of the controller. This has been proven with numerical simulation and experimental testing on a 1 DoF wire-driven robot prototype.