Stability of a telerobotic manipulation system with proximityased haptic feedback

Roberto Oboe

Università di Padova

Recently, a telerobotic equipment has been proposed for the assistance of the human operators, during the execution of immerse ultrasound examinations. This is usually a difficult task, as the ultrasound probe must be held at some distance from the surface to be scanned, and the distance perceived by the human eye can be affected by the optical distortion produced by the liquid. Additionally, the operator must devote all her/his attention to the ultrasound images, then the visual control of the operation would be quite annoying. Automated placement of the probe, on the other hand, may lead to unsatisfactory results and a fine, operatorriven trimming may be required to obtain the best ultrasound image. Therefore, a master/slave system with haptic feedback has been proposed as a novel solution to assist the clinician to achieve an optimal positioning of the probe while performing an immerse ultrasound examination. Being a nonontact task, a custom proximity sensor is used to estimate both the distance and orientation of the probe from the surface to be scanned. Such information is used both to control the probe orientation and to generate a feedback force at the master side, which simulates the presence of a virtual constraint, with a user-defined mechanical impedance, located above the object surface. This presentation, after describing the overall system, addresses the study of the stability of the proposed teleoperator during surface following.