Utilization of Kinematical Redundancy of a Rehabilitation Robot to Produce Compliant Motions under Limitation on Actuator Performance

Takaaki Goto¹ Hiroki Dobashi¹, Tsuneo Yoshikawa¹, Rui C. V. Loureiro², William S. Harwin³, Yuga Miyamura¹ and Kiyoshi Nagai¹

Abstract—This paper addresses the mechanical structure and control method of a redundant drive robot (RDR) to produce compliant motions, and show how the design parameters of the RDR can effect the produced motions and the mechanical and performance limitations of the actuators of the RDR. The structure and control method of the RDR can have been proper to produce compliant motions, but the effect of the design parameters of the RDR to the mechanical and performance limitations have not been clear. Therefore, the feasibility of producing compliant motions in the case of the prototype of the RDR is confirmed by conducting simulations and experiments, and then the design parameters of the RDR to the mechanical and performance limitations are verified by Nagai et al. [11]. The paper also discussed the limitations imposed by actuator performance on the design of a prototype of RDJ-DA [12]. Goto et al. proposed an alternative RDR for producing 1 DOF motion at the endpoint, in which the two robotic joints are driven by the sum and difference of the two actuator torques [13]. The paper showed that it a reduction of inertia at the endpoint is possible. Nagai et al. showed the feasibility of including EEG measurements in the control structure of an RDR robotic system for stroke rehabilitation [14].

However, the role of the design parameters introduced in this paper is not discussed.