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ROBUST TASK-SPACE CONTROL OF ROBOT MANIPULATORS UNDER IMPERFECT TRANSFORMATION OF CONTROL SPACE

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Abstract. *Robust control approaches have been extensively developed to control robot manipulators in joint-space. Even though they can present perfect tracking performances in joint-space, they cannot provide satisfactory performances in workspace under imperfect transformation of control space. In addition, many task-space approaches have assumed the perfect transformation, which is not real with presence of uncertainties. This paper presents a novel task-space robust control approach with suitable tracking performance under the imperfect transformation. The importance of this paper is due to canceling the effects of imperfect transformation, which makes it superior to others. Feedbacks from both task-space and joint-space are used for this purpose. The proposed control law is derived based on the direct method of Lyapunov to guarantee stability with presence of both structured and unstructured uncertainties. The control system is equipped by a filter to remove chattering from control inputs. A two-links elbow robot is then simulated to show the performance of control system.*

Keywords: Control spaces, Imperfect transformation, Robot manipulator, Robust control, Task-space, Uncertainties

1. **Introduction.** The dynamics of robots are highly nonlinear with large couplings and uncertainties in model. Despite this, the most adopted controller in industrial settings is still the proportional–integral–derivative (PID) with additional features like filters, feedforward actions and so on [1]. Although simple controllers such as PID controllers are effective for regulating purposes [2], they cannot work well for tracking purposes. Instead, model-based controllers can work perfectly [3]. However, if exact models are available they might be very large with low response and difficult to implement.

There is a challenge in robot control to overcome uncertainties, nonlinearities and couplings from different aspects as surveyed in [4-7]. The use of neural networks and fuzzy logic has attracted a great deal of research in robust control to deal with uncertainties and time delay [8-12]. So far, the robust control approaches have been extensively developed for tracking purposes by using feedbacks from joint-space. This field includes various methods to deal with uncertainties such as adaptive control [13], sliding mode control [14], observer-based control [15], H∞ control [16], genealogical decision tree control [17], neural control [18] and fuzzy control [19]. They all perform tracking purposes very well in joint-space under uncertainties. However, none of them can provide satisfactory tracking performances in workspace if we use imprecise transformation from task-space to joint-space.