

## **Operator & Learning-Based Nonlinear Modelling and Control of Micro Hand**

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### **Abstract**

Soft actuators have been getting increased attention with developing of medical fields etc. However, to control the actuator and make its model accurately are difficult because the actuator has complex nonlinearity. Moreover, the actuator should be controlled without sensor because its expected application are medical fields, especially, in operations. On the other hand, a control system based on operator theory can apply nonlinear systems with uncertainties. The relationship between operator theory and passivity or adaptive control which is an important idea in control engineering has discussed by some researchers. Meanwhile, support vector regression (SVR) has been utilized for classification and regression analysis, where the design parameters are selected by using particle swarm optimization (PSO). Therefore, operator-based control system is discussed. In order to realize sensorless control, PSO-SVR-based moving estimation with generalized Gaussian distribution (GGD) kernel is employed. That is, operator-based sensorless adaptive nonlinear control system considering passivity for the actuator and PSO-SVR-based moving estimation with GGD kernel are shown. Especially, for 3D micro-hand, modeling is proposed by using multi-output support vector regression (MSVR) and ant colony optimization (ACO). MSVR estimates the input-output relation of the micro-hand. ACO optimizes the parameters of the MSVR model. Finally, some simulations and experimental results are introduced.

### **Biography**



Prof. Mingcong Deng is a Professor of Tokyo University of Agriculture and Technology, Japan. He received his BS and MS in Automatic Control from Northeastern University, China, and PhD in Systems Science from Kumamoto University, Japan, in 1997. From 1997.04 to 2010.09, he was with Kumamoto University; University of Exeter, UK; NTT Communication Science Laboratories; Okayama University. Prof. Deng is a member of SICE, ISCIE, IEICE, JSME, IEEJ and the IEEE(SM). He specializes in three complementary areas: Operator based nonlinear fault detection and fault tolerant control system design; System design on thermoelectric conversion elements;

Applications on smart material actuators. Prof. Deng has over 550 publications including 175 journal papers, 15 books (or chapters), in peer reviewed journals including IEEE Transactions, IEEE Press (for books) and other top tier outlets. He serves as a chief editor for International Journal of Advanced Mechatronic Systems, The Global Journal of Technology and Optimization, and associate editors of 6 international journals, including with IEEE journal. Prof. Deng is a co-chair of agricultural robotics and automation technical committee, IEEE Robotics and Automation Society; also a chair of the environmental sensing, networking, and decision making technical committee, IEEE SMC Society. He was the recipient of 2014 Meritorious Services Award of IEEE SMC Society and 2019 Meritorious Services Award of IEEE SMC Society .