Keynote Speech

Title: *Synthesis and Optimization of Parallel and Hybrid Manipulators*

Abstract: Accuracy is one of the most crucial factors which affects the profound laboratory research and extensive industrial application of parallel robotic manipulators. Kinematic calibration is a necessary approach to make the nominal value approximately equivalent to the actual value for the pose of end-effector under different input of actuation variables. Since the error source of parallel manipulator is strong coupling, highly nonlinear, and uncontrollable, the pseudoerror theory is proposed by considering multiple errors, including manufacturing and assembly error, thermal error, and nonlinear stiffness error, as a single hypothetical error source, which only causes the deflection of joint variables. A novel cooperative coevolutionary neural network (CCNN) is designed to establish the complex nonlinear relationship between joint variables and the related deviation with respect to the measured pose of the end-effector. With CCNN, the pseudoerror in arbitrary joint configuration can be obtained, and thus, the control parameters can be adjusted accordingly. The results are validated through the case studies about a parallelogram-based 3-DOF parallel manipulator and a parallel robotic machine tool. This approach is generic and feasible for all types of robotic system.

Since performance improvement is one of the most important factors that greatly affect the application potential of hybrid manipulators in different industry fields, to deeply investigate the comprehensive features, the local/global performance indexes of stiffness, dexterity, and manipulability are mathematically modeled and mapped. A discrete-boundary-searching method is developed to calculate and visualize the workspace. Pareto-based evolutionary multi objective performance optimization is implemented to simultaneously improve the four indexes, and the representative nondominated solutions are listed.