

# A Novel Compliance Compensator Capable of Measuring Six-Axis Force/Torque and Displacement for a Robotic Assembly

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**Abstract**— This article proposes a novel compliance compensator that can measure six-axis force, torque and displacement. The proposed device can provide the information necessary for feedback control while protecting the robot from impact. The device was designed based on a 6-DOF parallel mechanism to have six-axis sensing and deform greatly at the rated load without failure. We designed new flexure links with flexure joints connected in series, which facilitates fabrication and stiffness analysis. Through the stiffness analysis, the measured force can be converted to displacement and the stiffness of the device can be customized to the desired value by simply adjusting the thickness of the links. The sensing performance was evaluated through experiments using a commercial force/torque sensor (F/T

sensor) and precision stages. We also propose a displacement-based misalignment compensation method in a robotic peg-in-hole assembly using the proposed device. The method uses the intrinsic passive compliance of the device and measured displacement, not the force and torque. We reduced the reaction force generated in the peg-in-hole assembly by 92.6% through the proposed method. The proposed method is simple and intuitive, and can be used for automatic teaching of the manipulator.

**Keywords**— *Force, Robot sensing systems, Force measurement, Torque, Displacement measurement, Torque measurement, Strain measurement component*

- [1] Sunghyun Choi, Donghyun Kim, Youngeun Kim, Yeon Kang, Jingon Yoon, Dongwon Yun, "A Novel Compliance Compensator Capable of Measuring Six-Axis Force/Torque and Displacement for a Robotic Assembly," IEEE Transaction on Mechatronics, vol. 29, issue 1, pp. 29-40, Feb 2024

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