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Vibration Compensation of an Extendable Variable-Stiffness Boom-Lift-Mounted Robot

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***Abstract*—Boom lifts are commonly utilized in various industries to provide safe and efficient access to elevated work areas. Recently, a boom-lift-mounted robot (BLMR) concept has been proposed, combining a boom lift and an industrial robot to facilitate enhanced levels of construction automation. However, boom lifts typically contain extendable large-scale, variable-stiffness structures, subject to complex nonlinear static deformation and dynamic motion/gust-induced vibrations. These issues hinder the BLMR's precise and safe operation. To address these issues, this paper proposed a static deformation compensation scheme and a vibration alleviation method based on the inertial measurement unit (IMU). The deformation exploits the measurement from a laser tracker, while the vibration compensation method synergistically exploits the extended Kalman filter of the IMU measurements at the tip and the robot motion's dynamic contribution to vibration under a real-time feedback framework. A telescope-type BLMR prototype is built to verify the proposed method. The proposed method is compared with a time-varying input shaper concerning the extension-dependent natural frequencies and damping ratios. Enhanced accuracy of the BLMR operation has been experimentally illustrated.**

***Index Terms*—Construction robot, boom-lift-mounted robot, vibration compensation, extension-dependent vibration**

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