Sensor-agnostic Visuo-Tactile Robot Calibration Exploiting Assembly-Precision ModelGeometries

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Visual sensor modalities dominate traditional robot calibration, but when environment contacts are relevant, the tactile modality can provide another natural, accurate, and highly relevant modality. Most existing tactile sensing methods for robot calibration are constrained to specific sensor-object pairs, limiting their applicability. This research pioneers a general approach to exploit contacts in robot calibration, supporting self-touch throughout the entire system kinematics by generalizing touchable surfaces to any accurately represented mesh surface. The approach supports different contact sensors as long as a simple single-contact interface can be provided. Integrated into the ATOM calibration methodology, a generalized calibration approach, our work facilitates seamless integration of both modalities in a single approach. Our results demonstrate comparable performance to single-modality calibration but can trade off accuracy between both modalities, thus increasing overall robustness. Furthermore, we observe that utilizing a touch point at the end of a kinematic chain slightly improves calibration over touching the chain links with an external sensor but find no significant advantage of restricting touch to end-effector contacts when calibrating a dual-arm system with our method.

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FIGURE 1
The robot used: an altered PR2 with a Shadow Hand equipped with BioTac sensors on its right hand.

FIGURE 2
The author calibrating the robot.