GUOQING ZHANG

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PROFESSIONAL SUMMARY

Robotics engineer (end-to-end system development) and Ph.D. candidate with 5+ years building continuum-robot research prototypes—from mechanical design and modeling to state estimation, embedded/ROS2 integration, and experimental validation. Hands-on with SolidWorks, C++/Python/MATLAB, ROS2, and HIL prototyping using Speedgoat/Simulink Real-Time and EtherCAT. Industry R&D experience with Johnson & Johnson.

TECHNICAL SKILLS

Programming: C++, Python, MATLAB
Robotics/Controls: ROS2/ROS, state estimation (EKF/IMM), sensor fusion, kinematics/statics
Real-Time & Tools: Simulink, Simulink Real-Time (Speedgoat), EtherCAT, Git, Linux
Design & Hardware: SolidWorks, motor/servo drives, embedded I/O, IMU/EM/vision sensing, cable-driven actuation

EXPERIENCE

Robotics & Controls Consultant — Johnson & Johnson (Ottava Program), Remote *Oct 2021 – May 2022*

- Derived continuum-instrument kinematics and geometric Jacobians for a cable-driven bending wrist with leader insertion/roll; validated Jacobians numerically and documented modeling conventions.
- Implemented a configuration-space EKF observer estimating $(\delta, \theta, i, \phi)$ from OptiTrack pose; derived analytic measurement Jacobians and added a quaternion-based formulation to reduce rotation redundancy.
- Built a pose-error analysis pipeline (Gaussian position ellipsoid + Bingham/quaternion orientation statistics) to quantify performance (typically <5 mm / $<5°$, worst-case ~17 mm / ~23°); proposed online dynamic compensation using recursive/Kalman-style gain estimation for backlash/extension effects.

System Engineer Intern — Auris Health (Johnson & Johnson), Remote *May 2020 – Aug 2020*

- Built a Simulink Real-Time (Speedgoat) rapid-prototyping workflow with auto C code generation, enabling online tuning and 1 kHz cycle-level logging; shortened control iteration from days to hours.
- Integrated real-time IO across Elmo drives, EM tracker, sheath/IDM hardware, and torque sensing to create an end-to-end closed-loop test platform for verification and debugging.
- Delivered validated demos: IDM motor characterization (sine/chirp excitation + System Identification Toolbox transfer-function fits) and instrument control features (tensioning/init and improved trajectory planning, e.g., quintic profiles).

Graduate Researcher — Stevens Institute of Technology, Hoboken, NJ *Aug 2019 – Present*

- Developed stochastic shape estimation in polynomial-curvature state space; implemented adaptive multi-model filtering (IMM-EKF) for robustness under sparse/noisy sensing and varying deformation regimes.
- Demonstrated strong estimation accuracy (e.g., 0.38% tip position, 0.24% shape position, 0.63°/100 mm tip bending for the best-performing adaptive variant).
- Built an integrated shape–force estimation framework using polynomial-curvature kinematics + virtual work combining cable tensions with tip pose; achieved 0.20 mm arclength-averaged shape-position MAE and 0.05 N overall force MAE (PCK2).
- Ongoing: developing SE(3) shape–wrench estimation for continuum robots (in preparation), targeting Lie-group-consistent modeling/filtering and runtime-characterized real-time feasibility.

EDUCATION

Ph.D. Candidate, Mechanical Engineering (GPA: 3.97) — Stevens Institute of Technology *Aug 2019 – Present*
M.S., Mechanical Engineering (GPA: 3.7) — Columbia University *Jul 2017 – Dec 2018*

SELECTED PUBLICATIONS

- **G. Zhang** and L. Wang, "Stochastic Adaptive Estimation in Polynomial Curvature Shape State Space for Continuum Robots," in **IEEE Transactions on Robotics**, doi: 10.1109/TRO.2025.3637147.
- Q. Zhao, **G. Zhang**, H. Jafarnejadsani, L. Wang. "A Modular Continuum Manipulator for Aerial Manipulation and Perching". ASME IDETC, 2022.
- **G. Zhang**, Z. Chen, and L. Wang. "Integrated Shape-Force Estimation for Continuum Robots: A Virtual-Work and Polynomial-Curvature Framework." Under Review at IEEE/ASME Transactions on Mechatronics.
- **G. Zhang**, Q. Zhao, and L. Wang. "Concurrent Estimation of Shape and External Wrench for Continuum Robots on SE(3) via Closed-Form Filtering." In preparation for **IEEE Transactions on Robotics (T-RO)**.