Sai Balusu

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Experience

Soft Materials and Structures Lab, Virginia Tech

Graduate Research Assistant Aug 2024 – May 2026

- Eliminated produce damage in autonomous grasping (**0/20 → 30/30** damage-free trials vs. joint-torque gating) by building a **Franka FR3** system that fuses a **Gemini vision pipeline**, octopus-sucker adhesion, and a **hybrid force-vision controller** compensating for soft-sensor hysteresis and creep.
- Engineered a **seven-layer soft capacitive tactile skin** (liquid-metal **SIS-Ag-EGaIn** composite, **Ecoflex**, plasma-treated PTFE electret) with a **20 mN** detection threshold, **>27 dB** SNR, and **<0.09 pF** jitter, replacing joint-torque gating.
- Scaled the single-taxel thesis sensor to a **4-taxel** skin with a custom **KiCAD** PCB (**AD7745** capacitance-to-digital converter + multiplexer) reading all **4 channels at ∼30 Hz**, to localize contact and estimate shear location and force magnitude.

Undergraduate Research Assistant Jan 2023 – May 2023

- Developed **LM-CNT-SIS composite** fabrication that prevents conductivity loss, validating a **segregated network** that holds up at high strain.

FASER Lab, Virginia Tech Sep 2023 – May 2024

Undergraduate Research Assistant

- Owned the end-to-end design of a **Stewart platform** for **NASA's Borg Project**, reaching a **0.5 m** range of motion through iterative **SolidWorks** prototyping and fabrication.
- Built a **Python/ROS** robotic strut-assembly system for NASA truss research, validated in sim and hardware to cut assembly errors.

General Motors

Product Design Engineering Intern May 2023 – Aug 2023

- Cut base-part creation from **3 hr to 20 min** with standardized **NX** templates for impact bars/reinforcements; adopted dept-wide.
- Cleared **4** door components for production by auditing **weld compliance** and resolving the manufacturability risks found.
- Rebuilt Chevy truck door water deflectors with **NX sheet-body modeling**, simplifying the part so it met production-quality standards.

Product Design Engineering Intern May 2022 – Aug 2022

- Won prototype approval for **Equinox EV** seat packaging by optimizing seat and carpet-wrap geometry to **±0.02 cm** tolerances.
- Caught a **critical design error** validating **7+** components in **NX** and **Lifecycle Visualization**, averting a production failure.

Projects

Self-Designed Humanoid Robot (Leg Subsystem) Dec 2025 – Present

Personal Project

- Built a custom **8:1 cycloidal gearbox** reaching **70%** torque efficiency with high back-drivability, raising joint control authority.
- Designed and 3D printed an original **4-DOF leg** (articulating toe) in **SolidWorks**, the first subsystem of a fully self-designed humanoid.
- Drove the joints with **Eaglepower 8308** BLDC motors on **ODrive S1** FOC controllers over **CAN bus**, tuning cascaded position, velocity, and torque loops for joint trajectory tracking.

Leadership

Solar Car Team at Virginia Tech Aug 2021 – May 2024

Co-Founder; Vice President, Mechanical Team

- Co-founded the university's Solar Car team, growing it to **50+ members** and **$60K+** in sponsorship value; the first-generation team placed **12th** at the **2024 American Solar Challenge** and qualified for the **Formula Sun Grand Prix**.
- Led suspension design from concept to production in **SolidWorks** and secured the sponsorships that funded it.
- Optimized suspension geometry with **ANSYS** FEA, leaving standardized simulation files later cars reuse; machined and assembled the parts by hand, and the car passed every **technical scrutineering** phase.

Education

Virginia Tech – M.S. Mechanical Engineering | GPA: 3.7 Aug 2024 – May 2026

Thesis: soft capacitive tactile sensing for damage-free manipulation of fragile produce; manuscript in prep. for *Adv. Intelligent Systems*
Coursework: Applied Linear Systems (LQR, Kalman filtering), Nonlinear Control, Imitation Learning, Human-Robot Interaction

Virginia Tech – B.S. Mechanical Engineering, Robotics and Mechatronics | GPA: 3.6 Aug 2021 – May 2024

Skills

Robotics & Controls:	Hybrid force/motion control, tactile sensing, FOC, CAN bus, ROS, cycloidal actuator design
Mechanical:	SolidWorks, Siemens NX, Lifecycle Visualization, ANSYS FEA, tolerancing, DFM, 3D printing, machining
Electronics:	KiCAD PCB design, capacitance sensing, soft/stretchable sensor creation and fabrication
Programming:	Python, C++, MATLAB