BIJO SEBASTIAN

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LinkedIn Profile | GitHub Account | Blog

Industrial Experience

Product Owner   January 2021-Present
Behaviors, Planning and Controls Team
Torc Robotics, Virginia, USA

Software Engineer   November 2019-January 2021
Motion Planning Team
Torc Robotics, Virginia, USA

Education

Ph.D. Mechanical Engineering (CGPA:3.9/4.0)   January 2016-October 2019
Virginia Tech, USA
Dissertation: Traversability estimation techniques for improved
navigation of tracked mobile robots

M.Tech, Mechatronics (CGPA:9.45/10)   August 2013-August 2015
Academy of Scientific and Innovative Research, India
Thesis: Design, analysis, and development of climbing robot
Second rank in 2015 Mechatronics batch of four students from CMERI

B.Tech, Mechanical Engineering (CGPA: 9.03/10)   August 2009 - May 2013
University of Kerala, India

Best outgoing student from College of Engineering Trivandrum
Fourth rank in Kerala University, 2013 ME Batch

Research Experience

Software Engineer, Autonomy stack   November 2019 - Present

Torc Robotics, Virginia, USA

- Torc Robotics, with support from Daimler Family is trying to bring about autonomous vehicle technology to transform the way we travel, ship goods and do business. In my current role, I am responsible for software development along with engineering activities to support delivery of the Level 4 Autonomy Stack as part of overall system solution. From a software development

standpoint this involves developing algorithms to handle high level decision making, path planning and motion control while considering the perception data about the environment as obtained from the sensors in real-time. From an engineering standpoint this involves identifying benchmark tests, deploying and testing the algorithm performance in real world conditions and adding new capabilities to meet the autonomous navigation requirements.

Graduate Research Assistant   January 2016-October 2019

[Robotics and Mechatronics Lab](), Virginia Tech,
USA

- [Traversability estimation techniques for improved navigation of tracked mobile robots:]() Tracked robotic systems are widely used for search and rescue applications in challenging terrain conditions. For this use case, I have explored the use of Physics Engines to aid in path planning, developed Active Disturbance Rejection Control strategy to address vehicle slip and developed Support Vector Machine based architecture for real-time terrain identification.
- [Semi-Autonomous Victim Extraction Robot:]() Developed conceptual design for a robotic system capable of extracting an injured person from a disaster or war scenario and then evacuate them to a safe location for further medical attention. Developed simulations demonstrating casualty extraction capability using the proposed design. A US provisional patent has been filed on this design.
- [Development of a haptic exoskeleton glove:]() Design, integration of two different versions of exoskeleton gloves, which are lightweight, portable and acts as self-contained mechatronic systems. Optimized underlying mechanism to imitate natural finger motion, designed and developed miniature series elastic actuation systems to enable precise force control on each finger. A US patent has been filed on the developed design.

Project Fellow   June 2014-November 2015

Surface Robotics Lab, [CSIR-CMERI](), India

- [Design, analysis, and development of climbing robot:]() The proposed system was developed for horticultural and pipeline inspection applications. A novel design was developed and validated through ADAMS–MATLAB Co–Simulation. A complete prototype was integrated with actuators, sensors, and necessary control software to make the prototype fully operational. Experimental validation of the proposed design and climbing strategies were also performed.
- [Validation of Navigational algorithms on PIONEER P3-AT platform:]() Developed and tested various state of the art algorithms for path planning and localization along with control strategies for obstacle avoidance and goal seeking to create a complete navigation module. Implemented and tested these algorithms on a simulated PIONEER P3-AT as well as a real ROVER 5 platform with integrated sensing and onboard processing.
- [Automated mechanism for plate washing:]() A novel plate washing mechanism specifically designed for removing oily food waste from plates. The proposed system was developed into a prototype and a design registration has been filed on the same under CSIR.

- **Design of a spherical robot with simplified drive mechanism:** A modified pendulum drive system was designed for a spherical robot. In addition to being completely self-contained, the proposed design is much simpler and more versatile than the existing spherical robot designs.

For additional detail on the above projects refer to homepage.

Selected publications

- **Sebastian, B.,** Ben-Tzvi, P., "Physics Based Path Planning for Autonomous Tracked Vehicle in Challenging Terrain" *Journal of Intelligent and Robotic Systems*, Springer, Vol. 95, Issue 2, pp. 511-526, August 2019. DOI: 10.1007/s10846-018-0851-3
- **Sebastian, B.,** Ben-Tzvi, P., "Active disturbance rejection control for handling slip in tracked vehicle locomotion", *Journal of Mechanisms and Robotics*, Transactions of the ASME, Vol.11, Issue 2, pp. 021003:1-12, April 2019 DOI: 10.1115/1.4042347
- **Sebastian, B.,** Ben-Tzvi, P., "Support Vector Machine Based Real-time Terrain Estimation for Tracked Robots", *Mechatronics*, Elsevier, Vol. 62, pp. 102260, October 2019. DOI: 10.1016/j.mechatronics.2019.102260
- Chauhan, R., **Sebastian, B.,** and Ben-Tzvi, P., "Grasp Prediction Toward Naturalistic Exoskeleton Glove Control," *IEEE Transactions on Human-Machine Systems*, vol. 50, no. 1, pp. 22-31, February 2020, DOI: 10.1109/THMS.2019.2938139
- Williams, A., **Sebastian, B.,** Ben-Tzvi, P., "A Robotic Head Stabilization Mechanism for Medical Transport", *Robotics*, Multidisciplinary Digital Publishing Institute, Vol. 8, Issue 1, pp. 23, March 2019. DOI: 10.3390/robotics8010023
- Williams, A., **Sebastian, B.,** & Ben-Tzvi, P., "Review and Analysis of Search, Extraction, Evacuation, and Medical Field Treatment Robots", *Journal of Intelligent and Robotic Systems,* Springer, Vol. 96, pp. 401–418 February 2019. DOI: 10.1007/s10846-019-00991-6
- Refour, E. M., **Sebastian, B.,** Chauhan, R. J., and Ben-Tzvi, P. "A General Purpose Robotic Hand Exoskeleton With Series Elastic Actuation." *Journal Mechanisms and Robotics*. December 2019; 11(6): 060902.DOI: 10.1115/1.4044543

For the complete list of publication please refer to my Google Scholar profile.

Patents

- Ben-Tzvi, P., **Sebastian, B.,** Refour, E., Xu, W., Pradhan, S., Guo, Y., "Robotic exoskeleton glove system," U.S. Patent Pending No.16888993, Dec 3, 2020.
- Ben-Tzvi, P., Williams, A., **Sebastian, B.,** Kumar, A., Saab, W., "Semi-Autonomous Victim Extraction Robot (SAVER)", U.S. Provisional Patent Application No. 62/836,915, April 22, 2019.

Honors and Awards

- "AugHit", Augmented Realty Robotics competition - **2nd Prize**, Kshitij Techno-Management fest, IIT Kharagpur, India, 2015
- Ideation contest 2014 - **Participation prize** for "Detailed design of novel spherical robot", TePP Outreach cum Cluster Innovation Center, CSIR-CMERI, Durgapur, India

- Student Mechanism Design Contest - **First Prize** for "Design and integration of novel mechanism for plate washing", iNaCoMM 2013, IIT Roorkee, India
- Col. P. Vaidyanathan Memorial Endowment and K. Thomas Kora Memorial Award - **Best Outgoing Mechanical Engineering Student** College of Engineering, Thiruvananthapuram, India; March 2014
- **Certificate of Commendation** for Co-ordinating Technical Paper Presentation, Drishti 2012, College of Engineering, Trivandrum, India

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Leadership and Service

- **Product Owner, Behaviors, Planning and Controls Team, Torc Robotics:** My current role as PO under Torc Robotics team requires me to mentor and guide a team of five Software developers on a daily basis.
- **Conducted Seminar:** On the topic "Introduction to Robotics" to Master students within the Department of Physics at Newman College, Kerala India.
- **Conducted Robotics Workshop:** Including lectures and hands-on sessions as part of a two-day robotics workshop for undergraduate students.
- **STEP 4 U Instructor:** Volunteered under Kerala state government sponsored program and took support lectures on computer programming for undergraduate students.

Relevant courses

- **Masters Course work:** Introduction to Mechatronics Systems, Robotics, Micro controllers &Embedded System Design, Introduction to Computer Vision, Analytical Mechanics
- **PhD Course work:** Multi-Body Dynamics, Advanced Mechatronics, Applied Linear Systems, Non-linear Systems Theory, Adaptive Control Systems, Advanced Robot Motion Planning, Model Based Estimation

Skills

- **Programming:** C++, Python, MATLAB/Simulink
- **CAD and design software:** SolidWorks, Pro/ENGINEER, Autodesk Eagle
- **Modelling and Simulation software:** Gazebo, V-REP, Webots, MSC ADAMS
- **Robotics software packages/libraries:** Pybullet, ROS, OpenCV, Git, Scikit-learn