Dr. Vilas K. Chitrakaran, Ph.D., C.Eng. (MIET)

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About me

I am a Systems Architect and a Chartered Engineer. My technical expertise is in software engineering for industrial automation (manufacturing/intralogistics/nuclear/aerospace), embedded systems, robotics (consumer/industrial) and unmanned vehicles. I am also a people leader who leads by providing my team autonomy, sense of purpose, and opportunities to excel.

Areas of Expertise

- **Product development**: Full lifecycle from concept (TRL1) to product (TRL8).
- **Leadership**: Technology strategy, funding proposals, personnel/team development.
- **Robotics**: Distributed real-time control architectures for large industrial robotic fleets, Kinematic and dynamic modeling of articulated and mobile robots, algorithms for localisation and navigation of autonomous vehicles, design of command and control systems and human-machine interfaces, immersive 3D visualization and simulation systems, machine vision.
- **Tools and Technologies**: Multi-paradigm software design - C++23, Python; distributed systems - MPI, DDS; algorithm prototyping - MATLAB, ROS, OpenCV, PCL; graphical system design - OpenInventor, Qt; OS/RTOS kernel programming - Linux, QNX Neutrino; code compliance - MISRA, JSF AV Rules; safety - ISO26262, ISO13482, ANSI/ITSDF B56.5.

Professional Experience

- **Principal Roboticist**   *2018 - 2023*
  Arrival, London, United Kingdom

  - For all things software in Mobile Robotics, the buck stopped with me.
  - Conceived the software architecture for Arrival's industrial mobile robot fleet, a distributed system of hundreds of robotics agents working as one to deliver Arrival's vision of flexible (i.e. software-defined) manufacturing.
  - Nurtured a globally distributed software team that built the above. I led by example, setting technical and ethical standards for myself, and built a team of high performing, honest, empathetic, accountable individuals with a deep sense of purpose and mission. My approach to leadership is highlighted in an article that I wrote in order to attract talent: https://medium.com/@vilaschitrakaran/colleagues-wanted-4b293c6f1062
  - In collaboration with my team, I set down standards and processes that enabled us to continuously deliver software into the production environment every two weeks.

- **Senior Systems Engineer**   *2017 - 2018*
  Intelligent Robots Limited, London, United Kingdom

  - Directed concept research and systems engineering to build "the world's simplest conveyor robots" for intra-logistics.
  - Cultivated academic and industrial collaboration; Authored and won a competitive funding grant from Innovate-UK to develop a prototype of the product for commercial validation.

- My team delivered. However, the company did not succeed. Hardware is hard!

- **Senior Robotic Algorithms Engineer** *2013 - 2017*
  Dyson, Malmesbury, United Kingdom

  - Member of the team that delivered the Dyson 360 Eye robot, their first commercial robotic vacuum cleaner. Improved robustness of its visual navigation system in the areas of camera calibration, high dynamic range omni-directional imaging, illumination system, localisation and mapping system. My approach to product improvements were data-driven, based on extensive user trials and lab tests.
  - Led a technical team that implemented a high precision embedded visual-inertial odometry system for next-generation floor-care robots.
  - Developed system specifications for a ground-truth motion validation system, customized a commercial off-the-shelf solution that met the requirements, agreed on the terms of IP ownership with vendors, directed its commissioning and organized training sessions for end-users.
  - Went on technology scouting missions to bring mature academic research into commercial products.
  - Led discussions with multinational vendors to influence their product development to align with the needs of the business.
  - Represented the company at trade shows (eg. The Gadget Show 2015) and external events to evangelize on behalf of the company.

- **Senior Software Engineer** *2012 – 2013*
  Guidance Navigation Limited, Leicester, United Kingdom

  - Affiliated with Guidance's Innovation Center, I worked closely with leading researchers at Oxford University's Robotics Institute to transfer their natural feature navigation technology to Guidance, an activity of strategic importance to the company.
  - Developed design specifications for a driverless control system for a manual fork-lift truck. BS-EN 1525:1998 standard (Safety of Industrial Trucks. Driverless Trucks and Systems) provided the basis for this work, given the requirement for safe operation of the vehicle in human environments.
  - Delivered performance improvements to autonomous navigation technologies by modifying the underpinning nonlinear least squares based mathematical formulation.
  - Visited strategically important customers for on-site product testing and validation.

- **Senior Engineer** *2011 – 2012*
  Blue Bear Systems Research, Bedford, United Kingdom

  - Research and development of unmanned aerial vehicles for urban ISTAR (Intelligence, Surveillance, Target acquisition and Reconnaissance) operations.
  - Worked with academic partners to find commercial applications for their research.
  - Worked with prime vendors in the defense sector on government-funded projects, one of which was the development of software-based simulators for verification and validation of subsystems on the Long Endurance Multi-Intelligence Vehicle (LEMV).
  - Participated in flight trials. Improved efficiency and safety of flight ops by applying my experience as a qualified private pilot.
  - Represented the company at air shows and public events to demonstrate our products and capabilities.

- **Senior Systems Engineer** *2006 – 2011*
  OC Robotics, Bristol, United Kingdom

  - As a vision systems specialist, I delivered a variety of tools such as 3D cameras (using the emerging technology of LCoS pico-projectors) and stereo vision systems for surface inspection, localisation and object identification. I specified hardware components such as imagers, optics, video processors, and

lighting, and delivered software for image analysis, machine vision and metrology.

- Applied my math-intensive academic background to extend Linear Programming concepts to design a novel model-based gravity compensation algorithm that enhanced the controllability of slender Snake-arm robots operating in highly confined environments.

- As one of only two software engineers in the company at the time, I delivered several human-machine interfaces (HMIs) for customers from a variety of industrial sectors (aerospace, nuclear and defense), each with unique functional and performance requirements. In designing such systems, I applied state-of-the-art research and best practices in Human Factors (e.g. Apple's OSX Human Interface Guidelines, or industry specific standards) to meet specifications for ergonomics, productivity, user-friendliness, and resistance to human errors.

- Snake-arm robots offer capabilities very different from typical industrial robots. I led a team of 3 engineers to deliver *Snake Arm Simulator,* a software-based professional simulation and analysis suite that demonstrated the unique capabilities of Snake-arm robots. My work included the development of requirements specifications for various versions of the product, concept design and design guidance documents for the development team.

- Proposed, designed and delivered a high-value software-based simulator platform for SAFIRE, a bespoke Snake-arm robot to conduct inspections within the Upper Feeder Cabinets of CANDU nuclear reactors. The simulator was used to train inspection engineers, and for mission planning during reactor inspection outages.

- Led a team of engineers and managed the development of a commercial proposal (valued at GBP 6 million) for a novel robotic inspection system for pressure vessels in an 'upstream' natural gas processing plant operated by one of the global oil and gas supermajors. I defined the scope of the project, worked with senior management on risk assessments and costings, directed a junior engineer in generating design options, and presented a comprehensive set of solutions to the customer. This included a proposal for an innovative software product for spatial and temporal geo-tagging of 3D environment models with visual inspection data (images, lidar scans, PDF reports, etc) to capture and archive inspection reports over time.

- Advocated the use of documentation tools, industry standard software development guidelines (JSF AV rules, MISRA C++) and code reviews to ensure high quality standards. The team was audited routinely by external agents for quality and always met ISO/IEC 90003:2004 requirements.

- **Graduate Research Assistant**, *Mechatronics Laboratory*   *2000 – 2006*
  Clemson University, SC, USA

  - Member of the technical team funded under DARPA's *Biodynotics* program to research the application of soft robotic manipulators. As part of a multi-disciplinary team dispersed across multiple universities, I led the electronics and control systems integration for the Clemson Octor bio-mimetic continuum robot. Crucially, I solved the challenge of shape measurement in continuum robots by an innovative application of cable-extension transducers (also called string potentiometers) used in automotive, aerospace and civil engineering industries. (http://cvilas.github.io/clemson-archive/projects/octor)

  - Key developer of the *Robotic Platform*, an open research and development platform for hard real-time robotic applications. The system integrated multiple robotic functionalities such as closed loop control, trajectory generation, an advanced numerical computation library and 3D visualization into a single homogeneous platform – a significant achievement at a time when such complex systems were typically implemented in a distributed fashion. (http://cvilas.github.io/clemson-archive/projects/rp)

  - Extended techniques familiar to the computer vision community towards theoretical development of new types of non-linear controllers and signal estimators using Lyapunov design methods. Applications included vision-based control of micro air vehicles, rigid body motion estimation, and structure-from-motion.

- http://cvilas.github.io/clemson-archive/projects/sfm
- http://cvilas.github.io/clemson-archive/projects/landing
- http://cvilas.github.io/clemson-archive/projects/follower

Education

- **Self Driving Car Engineer Nanodegree** _2018_
  Udacity
- **Ph.D.**, _Electrical Engineering (Focus: Robotics and Nonlinear Control)_ _2006_
  Clemson University, USA
  GPA 3.8/4.0
- **M.S.**, _Electrical Engineering (Focus: Robotics and Nonlinear Control)_ _2003_
  Clemson University, USA
  GPA 3.78/4.0
- **B.Eng.**, _Electrical and Electronics Engineering_ _1999_
  University of Madras, India
  GPA 85.6/100 (University Silver Medallist)

Additional Qualifications

- Chartered Engineer (CEng), awarded by the Engineering Council, UK, Feb 2016.
- Senior Member, Institute of Electrical and Electronics Engineers (IEEE).
- Flight Crew Licence (expired): JAR-FCL PPL(A) SEP (Land), UK Civil Aviation Authority, June 2010.