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Sagar Behere - Curriculum Vitæ

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Summary

Architect and systems integrator for complex, safety critical systems. PhD in architectures for highly automated driving. Skilled in software and firmware development, control systems design, functional safety, cybersecurity, embedded hardware, computer networking, and systems engineering. Recent focus has been on safety, verification, and validation of autonomous driving systems, with an emphasis on architecture strategy, algorithms, simulation, software+hardware implementations, and supporting (model based) systems engineering processes and tools.

Current role

Senior Director, Systems, Safety Engineering and Validation at Aurora Innovation Inc., Mountain View, USA: I help define and lead Aurora's rigorous engineering efforts to deliver safe and highly performant autonomous driving. I also direct safety research for autonomous driving.

Previous roles/projects

At Aurora Innovation Inc., in Mountain View, CA, USA

April 2020 – August 2021: **Director, Systems and Safety Engineering**

I helped define and lead Aurora's rigorous engineering efforts to deliver safe and highly performant autonomous driving. I also directed safety research for autonomous driving.

At Toyota Research Institute in California, USA

March 2018 – April 2020: **Senior Manager, Systems Engineering (Highly Automated Driving)**

Leadership for innovation and development in the following areas of highly automated driving:

- Complete System Reference Architecture (functional, software, hardware): Modular, scalable, high performance reference architecture poised to take advantage of changing requirements and technology.
- Functional Safety: Proof, evidence, arguments for absence of unreasonable risk.
- Systems Integration: Ensuring the vehicle-as-a-whole consistently exhibits desired behavior
- Model Based Systems Engineering: Technologies, tools, and processes to manage development of complex, safety-critical systems

August 2017 – March 2018: **Manager, AD Architecture and Functional Safety**

- Creating reference architectures for autonomous driving that can be tailored and instantiated across a variety of vehicle platforms
- Establishing goals, designs, technology and tools, verification and validation, and operational processes for functionally safe autonomous vehicles
- Systems engineering and integration

At Zoox Inc. – an autonomous driving startup in California, USA

August 2016 – July 2017: **Head of EE Integration**

- Create and manage the “function book” for vehicle integration. This defines how various bits of functionality come together to provide relevant customer and vehicle features e.g. energy management.
- Oversee drill down of E/E architecture and functional safety from previous role. Scope: all vehicle subsystems, emergency and safe stop strategies
- Define and implement cybersecurity architecture. Scope includes partitioning, specifying requirements on firewalls, gateways, individual ECUs and network communication, as well as establishment of in-house public key infrastructure for operational and supply chain support
- Establish systems engineering processes and tools for safety critical embedded systems. Scope includes practices for architecture representation, requirements management with traceability, selection and roll-out of an Application Lifecycle Management (ALM) tool across the company, and systems to generate compliance, testing, and activity reports for accident investigation and regulatory committees
- Define program management tasks, milestones and priorities for vehicle integration

October 2015 – August 2016: **Head of System Architecture**

- Led design and development of the novel vehicle platform which helped Zoox raise \$250 million in seed A funding
- Established baseline mechatronics (E/E) architecture for production intent autonomous vehicle. Scope included sensing/perception, compute, networking, cybersecurity, diagnostics, over-the-air updates, as well as distributed software architecture for vehicle dynamics control and communications middleware
- Led preliminary functional safety assessment (and subsequent revisions) of the production intent architecture. Scope included ISO26262 relevant lifecycle activities for analysis of

hazards and risks, establishment of safety goals, functional and technical safety concepts, redundancy management, selection of safety relevant implementation technologies and software/programming tools

- Established baseline electrical, control, and software architecture for the more “traditional” automotive areas: braking, steering, propulsion, body controls, HMI, and high availability low voltage power supply

With KTH, Sweden

2015

Developed an upgraded version of the [KTH Research Concept Vehicle \(RCV-2.0\)](#) to be used as the basis for a completely autonomous vehicle. Technology licensed to a private company.

2014

Developed Electrical/Electronic (E/E) system architecture for the [KTH Research Concept Vehicle \(RCV\)](#). The RCV platform is the basis for significant research at KTH and a number of its variants are commissioned by field-leading private companies in Sweden, Europe, and USA

2011+2012

Lead architect and developer of a [partially autonomous driving system](#) for a commercial truck. System demonstrated at the Grand Cooperative Driving Challenge, the Netherlands, 2011 and CoAct 2012 Driving demonstration, Sweden 2012.

2010

Developed a generalized [Motion Planning and Control system for robot manipulators](#) moving in the presence of obstacles. Demonstrated on 3 different robot platforms.

2009

Designed a [mobile robotics platform](#) with vision, manipulation and computation capabilities for EU FP7 cognitive robotics project CogX. Platform in use at 6 partner universities.

2008

Integration engineer for EU FP6 cognitive robotics project CoSy. Assignment involved [integrating research output](#) from all project partners into the robotics platform.

With Mahindra & Mahindra Ltd., India (M&M is one of India’s largest automobile companies)

2005–2007

[Developed a Common Rail Diesel Engine](#) for a commercial Sports Utility Vehicle, with vehicle integration and emissions engineering to meet Euro IV emission norms. Vehicle was launched in many countries in Europe, Africa, the Americas, Australia and India.

2004–2005

Developed a highly fault tolerant [system to program in-vehicle ECUs](#) at vehicle assembly line. System was used for several years at manufacturing plant during daily vehicle production.

2003–2004

Developed a hand-held, computer based [diagnostic tool](#) to read and resolve faults in vehicle ECUs. Tool was deployed to workshops and service centers across India.

Skills

Automotive

Electric powertrain, chassis control, energy management, HVAC, Body controls, infotainment, telematics

System Engineering

Model Based Systems Engineering (MBSE), SysML, UML, AADL, EAST-ADL, Requirements management, traceability, Polarion, architecture representation

Embedded hardware

Microcontrollers, board bringup, device drivers, clock synchronization, analog and digital i/o, dSpace autobox tools

Software

C/C++, Matlab/Simulink, Real Time Operating Systems (RTOS), Linux, Boost. Some familiarity

with Ada2012, Scala, Python, Java, Javascript, HTML, CSS, AngularJS, Networking, CAN, Ethernet, TCP/UDP IP, Data Distribution Service (DDS), ZeroMQ, various UNIX Inter-Process Communication (IPC), Universal Diagnostic Services (UDS)

Functional safety

HARA, FMEDA, Functional safety concept (FSC), Technical safety concept(TSC), Fault Tree Analysis (FTA), ISO26262 lifecycle, SOTIF

Cybersecurity

Asymmetric and symmetric encryption, hash digests, hardware security modules, public key infrastructure, certificate authorities, seed-key protocols

Languages

Fluent in English, Marathi, and Hindi. Working knowledge of Swedish. Basic knowledge of German, French, and Italian

Patents

- (Pending) System and method for detecting errors and improving reliability of perception systems using logical scaffolds
Application number US20210056321A1
Filed date January 17, 2020
- Internal Safety Systems for Robotic Vehicles
US Patent number 10303174
Publication date May 28, 2019
- Resilient Safety System for a Robotic Vehicle
US Patent number 10745003
Publication date August 18, 2020

Education

- [PhD in Machine Design](#). KTH, Sweden 2016
- [Licentiate in Machine Design](#). KTH, Sweden 2013
- Master in Systems, Control and Robotics. KTH, Sweden 2010
- Bachelor in Mechanical Engineering. University of Pune, India 2003

Distinctions

- Member of Standards Technical Panel (STP) for the [UL 4600](#) AV Safety Standard
- Invited expert/speaker/chair at industrial conferences and educational courses in Europe and USA. See [Invited talks](#)
- Represented Sweden in the area of autonomous systems, as part of a Swedish government+industry+academia delegation to explore cooperation with counterparts in Brazil, Nov. 2014, São Paulo
- M&M Product Innovation Award for best business driven product innovation in 2004-2005
- M&M Process Innovation Award for best business driven process innovation in 2005-2006
- M&M Outstanding Job Achievement Award for work on an electric hybrid vehicle displayed at the 8th Auto Expo in New Delhi in 2006
- Best Outgoing Student Award during final year of graduate studies

Teaching

- MF2044 Embedded Systems for Mechatronics, II (Spring 2012, 2013, 2014)
- MF2058 Mechatronics, Advanced Course (2013, 2014)
- MF2063 Embedded Systems Design Project (Autumn 2012)
- MF2042 Embedded Systems for Mechatronics, I (Autumn 2011)

Supervision

At KTH, Sweden

- Naveen Mohan (PhD. ongoing) Co-supervision of PhD research on architecture and methods for autonomous driving
- Adam Lundström (MSc. 2016) Co-supervision “Finding strategies for running Ada code in real-time on a Linux-based single board computer platform”
- Stefanos Kokogias (MSc. 2015) “Design and implementation of a fault tolerant controller on a prototype vehicle, using an active steering approach”
- Karin Fåhraeus (MSc. 2015) “Enhancement of the development process with software in the loop simulations, An embedded control case study”
- Jonathan Holmström (MSc.2015) “Lane keeping assistance using low-cost satellite aided positioning technology in modern highway navigation”
- Ioannis Tzioumakas (MSc. 2015) “Centralized environment database for vehicles”
- Daniel Eriksson and John-Eric Ericsson (MSc. 2014) “Indoor positioning and localization system with sensor fusion”
- Johan Schagerström (MSc. 2014) “Cow behavior monitoring with motion sensor”
- Johanna Simonsson and Kim Öberg (MSc. 2014) “Power consumption and optimization of an irrigation network”
- Daniel Lind, (MSc. 2014) “Performance evaluation of HTTP servers in embedded systems”
- Emelie Brus, (MSc. ongoing) “Controlling Wifi components from a web interface”
- Gustav Karlsson and Magnus Dormvik (MSc. 2011) “Construction of generic test environment for embedded systems”

Invited talks

- Challenges to V&V of Autonomous Driving
Workshop on Safe Autonomy and Practical AI, University of Southern California Center for Autonomy and Artificial Intelligence
12 November, 2021
- Safety Architectures for Autonomous Driving
Panelist at The Autonomous Main Event, Vienna, Austria
29 September, 2021
- Continuous Safety Cases for Automated Driving
Keynote talk at Operational Safe Systems (OSS.5) USA
12 July, 2021, USA
- [What Does Safety Mean for Automated Trucks?](#)
Panelist at AUVSI’s Automated Freight Summit
08 July, 2021
- [Where the Rubber Meets the Road: Ensuring Safe AV Road Testing](#)
Panelist at virtual event organized by the [Partners for Automated Vehicle Education \(PAVE\)](#)
04 November, 2020
- Robots in a human world
Panelist at ValleyML AI Expo 2020, USA
28 September, 2020
- How to develop a continuous safety case for autonomous driving?
Panel host and moderator at OSS.5 Conference, USA
24 February, 2020, San Francisco, USA
- Collaboration for the safety of autonomous vehicles
Invited panelist at State of AI and ML, Silicon Valley
14 January, 2020, Santa Clara, USA
- A commentary on the SOTIF draft
Panel host and moderator at The SOTIF Conference, USA
02 October, 2019, Austin, Texas, USA

- U.S. Dept. of Energy workshop on Advanced Computing for Connected & Autonomous Vehicles
Invited panelist on Automotive Systems Panel
07 May, 2019, UC Berkeley, USA
- Testing ADAS and Self-Driving Cars
Conference chairman
26-27 March, 2019, Munich, Germany
- [Building an AV Safety Case](#)
Invited talk at Operational Safe Systems for Level 5 Automation (OSS5)
28 February, 2019, San Francisco, USA
- Solving the Autonomous Vehicle Safety Assurance Challenge: A Discussion Featuring Leading Voices from Industry, Academia, and Governments
Invited panelist at IEEE ITSC '18 – The 21st IEEE International Conference on Intelligent Transportation Systems
06 November, 2018, Maui, Hawaii, USA
- Cybersecurity for Highly Automated Driving
Invited keynote at Vehicle Electronics and Connected Services (VECS) 2018
13 April, 2018, Gothenburg, Sweden
- Architectures, ODDs, and Testing of Autonomous Vehicles
Invited workshop at Testing ADAS and Self-Driving Cars
16 March, 2018, Dusseldorf, Germany
- Testing ADAS and Self-Driving Cars
Conference chairman
13-16 March, 2018, Dusseldorf, Germany
- Cybersecurity for Autonomous Vehicles
Invited workshop at Automotive Tech.AD
17 November, 2017, Detroit, USA
- New Concepts of Steer-by-Wire
Invited workshop at 4th International Conference Steering Systems USA 2017
14 June, 2017, Ann Arbor, USA
- Testing ADAS and Self-Driving Cars
Conference chairman
28-29 March, 2017, Frankfurt, Germany
- [Cybersecurity for Highly Automated Driving](#)
Invited speaker at Automotive Tech.AD
02 December, 2016, Detroit, USA
- Safety of Non-deterministic Functions
Invited speaker + Chairman of conference day 1 at System Safety 2016
19-21 September, 2016, Las Vegas, USA
- Preparing for the Robo-Taxi: Emerging Technology Perspectives
Invited Expert for Panel Discussion at AUVSI's workshop "The Future of Shared Mobility: Making the Robo-Taxi a Reality"
03 December, 2015, Jacksonville, USA
- Testing and Verification for Autonomous Driving
Moderated World-Café session at Automotive Tech.AD
17 November, 2015, Detroit, USA
- The Long Term Vision for Autonomous Driving
Moderated Round Table discussion at Automotive Tech.AD
16 November, 2015, Detroit, USA
- [Prototyping Cyber-Physical systems: A hands-on approach to the Cyber part](#)
EIT Digital summer school on Cyber-Physical Systems 2015
23 June, 2015, Stockholm, Sweden
- [A systems engineering approach to the design of complex systems](#)
EIT Digital summer school on Cyber-Physical Systems 2015

- 22 June, 2015, Stockholm, Sweden
- [A holistic approach to systems autonomy – For complex, intelligent, safety-critical systems](#)
1st Brazilian Swedish Workshop in Aeronautics and Defence, Aeronautics Institute of Technology (ITA)
14 November, 2014, São Jose dos Campos, Brazil
- The safety-availability tradeoff in autonomous driving
Moderated World-Café sessions at Automotive Tech.AD – The road towards autonomous driving
27 February, 2015, Berlin, Germany
- [Prototyping Cyber-Physical systems: A hands-on approach to the Cyber part](#)
EIT ICT Labs summer school on Cyber-Physical Systems 2014
04 July, 2014, Trento, Italy
- [A systems engineering approach to design of complex systems](#)
EIT ICT Labs summer school on Cyber-Physical Systems 2014
03 July, 2014, Trento, Italy
- [Pitfalls in Embedded Software \(and how to avoid them\)](#)
Embedded Systems II course (MF2044), KTH
31 March 2014, Stockholm, Sweden
- [Architecting for autonomy: Exploring the landscape](#)
ICES Workshop on Architectures for Autonomous Machines
14 January, 2014, KTH, Stockholm, Sweden
- [Vehicle architectures for increasing autonomy](#)
Elektronik i Fordon 2012
25 April, 2012, Gothenburg, Sweden

Publications

Book chapters

- [Systems engineering and architecting for intelligent autonomous systems](#)
Behere S., Törngren M
Chapter in book “Automated Driving – Safer and more efficient future driving”
Springer International Publishing (2017) DOI: 10.1007/978-3-319-31895-0_13 ISBN: 978-3-319-31895-0
- Functional safety and evolvable architectures for autonomy
Rolf Johansson, Jonas Nilsson, Carl Bergenhem, Sagar Behere, Jörgen Tryggvesson, Stig Ursing, Andreas Söderberg, Martin Törngren, Fredrik Warg
Chapter in book “Automated Driving – Safer and more efficient future driving”
Springer International Publishing (2017)
DOI: 10.1007/978-3-319-31895-0_25 ISBN: 978-3-319-31895-0
- Architecture and Safety for Autonomous Heavy Vehicles: ARCHER
Viktor Kaznov, Johan Svahn, Per Roos, Fredrik Asplund, Sagar Behere, Martin Törngren
Chapter in book “Automated Driving – Safer and more efficient future driving”
Springer International Publishing (2017)
DOI: 10.1007/978-3-319-31895-0_27 ISBN: 978-3-319-31895-0

Journals

- [Educating Embedded Systems Hackers – A practitioner’s perspective](#)
Behere S., Törngren M
ACM Sigbed Review – Special Issue on Embedded and Cyber-Physical Systems Education, Volume 14, Issue 1, October 2016, Pages 8-15
DOI: 10.1145/3036686.3036687
- [A functional reference architecture for autonomous driving](#)
Behere S., Törngren M.

Journal of Information and Software Technology

DOI: 10.1016/j.infsof.2015.12.008

- [A reference architecture for cooperative driving](#)

Behere S., Törngren M., Chen D.

Journal of Systems Architecture, Vol. 59, Issue 10, Part C, November 2013, Pages 1095-1112

DOI: 10.1016/j.sysarc.2013.05.014

- [The development of a cooperative heavy-duty vehicle for the GCDC 2011: Team Scoop](#)

Mårtensson J., Alam A., Behere S. et al

Intelligent Transportation Systems, IEEE Transactions on, vol.13, no.3, pp.1033-1049, Sept. 2012

DOI: 10.1109/TITS.2012.2204876

Conferences/Workshops

- ATRIUM – Architecting under uncertainty: For ISO 26262 compliance

Mohan N., Behere S., et al

IEEE International Systems Conference (SysCon) 2017, Montreal

DOI: 10.1109/SYSCON.2017.7934819

- A method for the systematic architecture of functionally safe automated driving: Leveraging diagnostic specifications for FSC design

Mohan N., Törngren M., Behere S.

SAE World Congress 2017

DOI: <https://doi.org/10.4271/2017-01-0056> ISSN 0148-7191

- A functional brake architecture for autonomous heavy commercial vehicles

Behere S., Zhang X., Izosimov V., Törngren M.

SAE World Congress 2016

DOI: 10.4271/2016-01-0134

- [A functional architecture for autonomous driving](#)

Behere S., Törngren M.

First International Workshop on Automotive Software Architectures (WASA) 2015, Montréal, Canada

- [Educating Embedded Systems Hackers: A practitioner's perspective](#)

Behere S., Törngren M.