Vivek Anand Sujan

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Citizenship: US Citizen

Summary: Vivek Sujan is currently developing advanced decarbonization research of commercial vehicles at the NTRC, ORNL. Prior to this, Vivek had been with Cummins Inc. for nearly 18 years. He was the Senior Technical Director leading the Advanced Technology Planning and Concept Development for the New Power Business Unit (NPBU, Cummins). He managed and lead Advanced Technology activities for the NPBU, focused on Hydrogen and Electrification Power Systems (systems and infrastructure, hybrid systems, batteries, motor generators, power electronics, e-accessories, e-drivetrain, PEM fuel cells, hydrogen storage, and supported products) for On- and Off-Highway applications. This included North America and Global markets. During this period, he has also held several positions with the Engine Business Unit and Research & Technology Department. Prior to working at Cummins Inc. Vivek worked as a Post-Doctoral Research Engineer at MIT/JPL-NASA for about 2 years, developing advanced control architectures for robotic systems in terrestrial and extra-terrestrial activities. Vivek received his BS degrees in Physics, Mathematics (1995) and Mechanical Engineering (1996) from CalTech, MS degree in Mechanical Engineering (1998), and a Ph.D. in Mechanical Engineering/Control Systems (2002) from MIT. He holds over 100 US and over 100 International Granted Patents in the field of Automotive Systems/Vehicles/Diesel engines, System Dynamics, Powertrains, Automation, Eco-Systems and Controls.

Experience:

National Transportation Research Center, Oak Ridge National Laboratory, DOE **June 2021 to Present**
Distinguished Research Staff, Vehicle Systems Integration Research **June 2021 to Present**

- Development of solutions for the decarbonization of commercial vehicles and systems

Cummins Inc. **Sept. 2003 to April 2021**
Senior Technical Director **May 2020 to April 2021**

- Focus on systems, component & disruptive green technology roadmap development to concept TRL development for alignment with production programs. Supporting both strategic and tactical engineering development (targeting Hydrogen and Electrified technologies).
- Leading Product Safety, Cybersecurity and Functional Safety (ISO26262) work product planning and management.
- Leading eco-system solutions development including optimum infrastructure architecture requirements, asset architecture development, and system/asset management/controls through real time customer interfaces. This includes defining charging solutions, vehicle architecture (component sizes) and fleet management supervisory controls.
- Leading Big-Data assimilation and characterization for hydrogen and electrified technology viability assessment and road mapping.
- Development of the NPBU Telematics and Connectivity strategy
- Leading the NPBU Intellectual Property strategy and development efforts.
- Identification and development of unique technical and business solutions for Hydrogen and Electrified freight corridors to drive technology adoption through end customer value adds
- Management of NPBU Advanced Engineering AOP and Budgets

Technical Director **July 2018 to May 2020**

- Lead the development and validation of Cummins' first organic Fuel Cell Electric Transit Bus and Class 8 truck projects, with showings at the 2019 NACV event.
- Development of the Autonomous Vehicle and Systems technical strategy and roadmap through deep fundamental mathematical/physics-based modeling using Big-Data and integration with Electrification for On- and Off- Highway applications.

- Technical assessment of multiple growth efforts within NPBU leading to electrification and hydrogen power acquisitions/partnerships for Cummins, including EDI, Hydrogenics, Loop Energy, Hyundai Motor Corp
- Development of Ultracapacitor and LiIon systems

Engine Market Innovation Director **July 2016 to June 2018**

- Lead the development of the Cummins Autonomous systems architectures and safety systems roadmaps and technologies
- Leading the technical support for Cummins Business Growth M&A activities related to the Engine Business Unit
- Technical lead for the development of vehicle platooning systems and commercial/business assessments of viability
- Development of a big-data framework and paradigm for systems and super-systems assessment (including mining real world vehicle data, entire US/NA roadway networks, electricity/grid characterization, development of advanced costing models)
- Lead the development of an inorganic telematics solutions capable of engine integration
- Lead the development of the engine business connectivity roadmap and features
- Lead the technical assessment of hydrogen systems and powertrains
- Development of the Market Innovation portfolio and strategy

Senior Technical Advisor **Dec. 2014 to June 2016**

- Electrified power systems lead for the Next generation ISL (Medium Duty) and ISC (Heavy Duty) on-highway mild-hybrid engine integrated solutions (including Motor-Generators and Power Electronics) for ULNOx management and CO2 improvements
- Advanced Stop-Start for ISL and ISX engines
- Advanced integrated look-ahead (eHorizon) with hybrid systems (multi-dimensional architecture and controls optimization) for both urban and rural applications
- Mild Hybrid vehicle systems development
- Development of a long-term vision and algorithms for Cummins Intelligent Vehicle management systems
- Mining haul trucks duty cycle adaptive controls

Technical Advisor **Sept. 2010 to Nov. 2014**

- Development of advanced systems and engine controls
- Systems Integration lead for SuperTruck I architecture development and advanced look-ahead eHorizon systems and features
- Advanced engineering system and control lead for the development of look-ahead eHorizon systems for On-Highway Long Haul and Off-Highway Mining Trucks.
- Systems integration lead for the development of Engine Stop-Start on Cummins ISB engines (including fast sync starts)
- Systems Integration lead for the development of the Advanced Gasoline Engines.
- Off-high IPA advanced system controls.

Technical Specialist **April 2007 to Aug. 2010**

- Development of advanced systems and engine controls
- Controls lead for the analysis and development of mild- and strong- hybrid systems
- Development of the Cummins Electrification Controls architecture that has been in use since 2008 through present time in our electrification systems.
- Controls lead for the development of an optimal controller for 7 air handling and combustions controls actuators including Variable Valve Timing/Cylinder Deactivation
- Mass Air Flow systems architecture to manage EGR/Charge Flow control, including drift, transport delay and air compressor correction
- Multitude of engine and aftertreatment systems flow control.

- Broad exposure to a wide array of automotive systems sensors, control modules, Rapid Prototyping Tools (dSPACE, NI Labview, etc.), test platforms (test benches, test cells and test vehicles), and production controls platforms/processes.

Senior Engineer **Sept. 2003 to March 2007**

- Development of Air Handling and Combustion Control for Diesel engine and aftertreatment systems.
- Developed a standalone aftertreatment thermal management and regeneration
- Standardized engine controls for engine/aftertreatment management
- Development of virtual sensors: Exhaust temperature, Turbine outlet temperature, PM estimation, Single and Multi-stage Turbine speed estimation
- Multiple coordinated air handling actuator control algorithms (EGR, VGT, Intake Air Throttle, Multi-Stage turbine control)
- Re-architecture of air handling systems for FCA products
- Closed loop engine combustion reference control for emission management; Open loop engine combustion reference for SCR warmup/TM/NOx controls
- Fuel system and injector controls

MIT Postdoctoral associate—Field and Space Robotics Laboratory **Sept 2002 to July 2003**

- Development of a cooperative robot system to explore new methods of visual information theoretic modeling and distribution architectures for orbital robots.

Caltech, JPL/NASA Visiting Scholar—Planetary Robotics Laboratory **May 2002 to Aug 2002**

- Development of a cooperative multi-agent architecture for the visual exploration of cliffs/unstructured environments

Education:

Doctor of Philosophy in Mechanical Engineering — June 2002
Massachusetts Institute of Technology — Cambridge, MA

Master of Science in Mechanical Engineering — June 1998
Massachusetts Institute of Technology — Cambridge, MA

Bachelor of Science Degree in Mechanical Engineering — June 1996
California Institute of Technology — Pasadena, CA

Societies:

EMA Autonomous Vehicle Subcommittee	2018 to Present
COMVEC Buckendale Award Committee	2016 to Present
DOE Co-Technologist In Residence	2015
SAE	2004
Sigma Xi – Research Honorary Society	1998
Tau Beta Pi – Engineering Honorary Society	1995
Phi Beta Kappa – Senior Honorary Society	1996
Sigma Pi Sigma – Physics Honorary Society	1994
Pi Mu Epsilon – Math Honorary Society	1993
ASME – student member	1994 to 1996

Selected Publications and Patents:

- Over 50 internationally published papers and over 200 patents granted in the fields of Automotive Systems/Vehicles/Diesel engines, System Dynamics, Powertrains, Automation, Eco-Systems and Controls.

Publications

Journal

1. Sujan, V. A., S. Dubowsky, and Y. Ohkami. *The Design and Implementation of a Robot Assisted Crucible Charging System.* Submitted to Robotics and Computer Integrated Manufacturing, International Journal of Manufacturing and Product and Process Development. International Federation of Automatic Control (IFAC).
2. Sujan, V. A., S. Dubowsky and Y. Ohkami. *Robotic Manipulation of Highly Irregular Shaped Objects: Application to a Robot Crucible Packing System for Semiconductor Manufacture.* Society of Manufacturing Engineers (SME) Journal of Manufacturing Processes, Volume 3, Number 3, 2002
3. Sujan, V. A. and Dubowsky, S. *Design and Implementation of a 3-D Mapping System for Highly Irregular Shaped Objects: with Application to Semiconductor Manufacture.* SPIE Optical Engineering, Vol. 41, No. 6, pp. 1406-1417, June 2002.
4. Sujan, V. A. and Mulqueen, M. P. *Fingerprint Identification Using Space Invariant Transforms.* Pattern Recognition Letters, International Association for Pattern Recognition, Elsevier Press, Mar 2002, Vol 23/5 pp. 609-619.
5. Sujan, V. A., and Dubowsky, S. *Design and Analysis of a Lightweight Hyper-redundant Deployable Binary Manipulator*. ASME Journal of Mechanical Design, Vol. 126, pp. 29-39, January 2004.
6. Sujan, V. A. and Dubowsky, S. *An Optimal Information Method for Mobile Manipulator Dynamic Parameter Identification.* Advances in Robot Dynamics and Control (ARDC), a Focussed Section of the IEEE/ASME Transactions on Mechatronics, Vol. 2, No. 2, June 2003
7. Sujan, V.A., Meggiolaro, M.A. *Model Predictive Disturbance Rejection During Cooperative Mobile Robot Assembly Tasks.* Journal of the Brazilian Society of Mechanical Sciences and Engineering (ISSN 1678-5878), Vol. 26, n.3, pp.260-268, 2004.
8. Sujan, V.A., Meggiolaro, M.A. *Improving the positioning accuracy of robotic manipulators subject to base oscillations.* ABCM Symposium Series in Mechatronics v.1 (ISBN 85-857699-20-3), Brazilian Society of Mechanical Sciences and Engineering, Rio de Janeiro, Brazil, pp.76-85, 2004
9. Sujan, V. A., Dubowsky, S., Huntsberger, T., Aghazarian, H., Cheng, Y. and Schenker, P. *An Architecture for Distributed Environment Sensing with Application to Robotic Cliff Exploration.* Autonomous Robots, Kluwer Academic Publishers, 16 (3): 287-311, May 2004.
10. Sujan, V. A. and Dubowsky, S. *Efficient Information-based Visual Robotic Mapping in Unstructured Environments.* International Journal of Robotics Research, Sage Publications, Volume 24, Issue 4, April 2005.
11. Sujan, V. A. and Dubowsky, S. *Visually Guided Cooperative Robot Actions Based on Information Quality.* . Autonomous Robots, Kluwer Academic Publishers, 19 (1): July 2005.
12. Sujan, V. A. and Meggiolaro, M. *On the Visual Exploration of Unknown Environments by Robots using Information Theoretic Metrics to Determine the Next Best View*. Focus on Robotics and Intelligent Systems Research. Mobile Robots: New Research, NOVA. Editors: John X. Liu, May 31, 2005. ISBN: 1-59454-359-3
13. Sujan, V. A. and Meggiolaro, M. A. *Intelligent and Efficient Strategy for Unstructured Environment Sensing using Mobile Robot Agents*. Publisher: Springer Science+Business Media B.V., Formerly Kluwer Academic Publishers B.V. ISSN: 0921-0296 (Paper) 1573-0409 (Online) DOI: 10.1007/s10846-004-3063-y Issue: Online First 07 October, 2005 Journal of Intelligent and Robotic Systems (ISSN 0921-0296), Vol 43, n.2-4, pp. 217-253, 2005.
14. Sujan, V. A., Meggiolaro, M. A., and Belo, F.A.W. *Information Based Indoor Environment Robotic Exploration and Modeling Using 2-D Images and Graphs*. Autonomous Robots (ISSN 0929-5593), Kluwer Academic Publishers, vol. 21(n.1), pp. 15-28, January 2006.
15. Sujan, V.A., Meggiolaro, M.A., Belo, F.A.W. *A New Technique in Mobile Robot Simultaneous Localization and Mapping*". Published in the Brazilian Control and Automation Journal (SBA, ISSN 0103-1759, Qualis NA), vol 17, n.2, pp. 189-204, 2006.
16. Sujan, V.A., Belo, F.A.W., Meggiolaro, M.A. *Mobile Robot Localization and Mapping Using Space Invariant Transforms*. ABCM Symposium Series in Mechatronics v.2 (ISBN 978-85-85769-26-0), Editors: P.E. Miyagi, O. Horikawa, E. Villani, Brazilian Society of Mechanical Sciences and Engineering, Rio de Janeiro, Brasil, pp.226-233, 2006.
17. Scofano, F.S., Meggiolaro, M.A., Sujan, V.A. *Inverse Kinematics of a Binary Flexible Manipulator Using Genetic Algorithms*. ABCM Symposium Series in Mechatronics v.2 (ISBN 978-85-85769-26-0), Editors: P.E. Miyagi, O. Horikawa, E. Villani, Brazilian Society of Mechanical Sciences and Engineering, Rio de Janeiro, Brasil, pp.202-209, 2006.
18. Guerrero de la Peña, A., Davendralingam, N., Raz, A., Jain, N., Shaver, G., DeLaurentis D., Sujan V.A. *Development and Validation of a Framework for Projecting Line-Haul Truck Technology Adoption using a System-of-Systems Methodology*. Transportation Research Part B. August 2018
19. Guerrero de la Peña, A., Davendralingam, N., Raz, A., Jain, N., Shaver, G., DeLaurentis D., Sujan V.A. *Projecting Line-Haul Truck Technology Adoption: How Heterogeneity Among Fleets Impacts System-Wide Adoption.* Journal: Transportation Research Part E: Logistics and Transportation Review. Volume 124, April 2019, Pages 108-127.

20. Guerrero de la Peña, A., Davendralingam, N., Raz, A., Jain, N., Shaver, G., DeLaurentis D., Sujan V.A. *Projection of Adoption Trajectories for Diesel and Alternative Powertrain technologies for Heavy-Duty Class 8 Vehicles in a Line-Haul Regional Network.* Transportation Research Part C: Emerging Technologies journal
21. Guerrero de la Peña, A., Davendralingam, N., Raz, A., Jain, N., Shaver, G., DeLaurentis D., Sujan V.A. Projecting Adoption of Truck Powertrain Technologies and CO2 emissions in Line-Haul Networks. Transportation Research Part D: Transport and Environment journal, 2019

Refereed Conference Proceedings

1. Sujan, V. A. and S. Dubowsky. *The Design of a 3-D Surface Geometry Acquisition System for highly Irregular Shaped Objects: With Application to CZ Semiconductor Manufacture.* Proceedings of IEEE International Conference on Robotics and Automation, Volume: 2, Page(s): 951–956, May 1999, Detroit, MI. U. S. A.
2. Sujan, V. A. and S. Dubowsky. *A Model-Free Algorithm for the Packing of Highly Irregular Shaped Objects: With Application to CZ Semiconductor Manufacture.* Submitted to the IEEE International Conference on Robotics and Automation, May 1999, Detroit, MI. U. S. A.
3. Sujan, V. A., S. Dubowsky and Y. Ohkami. *The Design and Implementation of a Robot Assisted Crucible Charging System.* Proceeding of the IEEE International Conference on Robotics and Automation, Volume: 2, Page(s): 1969 – 1975, April 2000, San Francisco, CA. U. S. A., 2000 Nominated/finalist for best paper in Manipulation.
4. Sujan, V. A. and S. Dubowsky. *Application of a Model-free Algorithm for the Packing of Irregular Shaped Objects in Semiconductor Manufacture.* Proceedings of the IEEE International Conference on Robotics and Automation, Volume: 2 Page(s): 1545 –1550, April 2000, San Francisco, CA. U. S. A.
5. Sujan, V. A. and M. A. Meggiolaro. *Sign Language Recognition using Competitive Learning in the HAVNET Neural Network.* Proceedings of the IS&T/SPIE 12th Annual International Symposium on Electronics Imaging. Applications of Artificial Neural Networks in Image Processing V, Vol. 3962, January 2000, San Jose, CA. U. S. A.
6. Sujan, V. A. and M. A. Meggiolaro. *Dynamic Optimization of a Geneva Mechanism.* Proceedings of the Tenth World Congress IFToMM International Conference on Gearing, Transmissions and Mechanical Systems, July 2000, Nottingham, U. K.
7. Lichter, M. D., Sujan, V. A., and Dubowsky, S. *Experimental Demonstrations for a New Paradigm in Space Robotics.* Proceedings of the Seventh International Symposium on Experimental Robotics, ISER '00. Hawaii, December 10 – 13, 2000. Also appearing in Lecture Notes in Control and Information Sciences (LNCIS) 271, Experimental Robotics VII, Editors-Daniela Rus and Sanjiv Singh, Springer-Verlag 2001.
8. Sujan, V. A. and M. P. Mulqueen. *Fingerprint identification using segmented Fourier-transformed preprocessing and competitive training in the HAVNET neural network.* Proceedings of the IS&T/SPIE 13th Annual International Symposium on Electronics Imaging. Nonlinear Image Processing and Pattern Analysis XII, Vol. 4304, January 2001, San Jose, CA. U. S. A
9. Sujan, V. A. *Rotational, Scale and Translation Invariant Pattern Recognition and Classification with Application to Sign Language Recognition*. Proceedings of the 5th World Multi-Conference on Systemics, Cybernetics and Informatics. International Institute of Informatics and Systemics. SCI/ISAS 2001. July 22-25, 2001. Orlando, Florida USA.
10. Sujan, V. A., Lichter, M. D., and Dubowsky, S. *Lightweight Hyper-redundant Binary Elements for Planetary Exploration Robots.* Proceedings of the 2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM '01). 8–11 July 2001, Como, Italy.
11. Sujan, V. A. and Mulqueen, M. P. *Image identification using the segmented Fourier transform and competitive training in the HAVNET neural network.* Proceedings of the IEEE International Conference on Image Processing (ICIP) October 7-10, 2001, Thessaloniki, Greece.
12. Lichter, M. D., Sujan, V. A. and Dubowsky, S. *Computational Issues in the Planning and Kinematics of Binary Robots.* Proceedings of the 2002 IEEE International Conference on Robotics and Automation, May 11-15, 2002, Washington, D. C., U. S. A.
13. Sujan, V. A. and Dubowsky, S. *Visually Built Task Models for Robot Teams in Unstructured Environments.* Proceedings of the 2002 IEEE International Conference on Robotics and Automation, May 11-15, 2002, Washington, D. C., U. S. A.
14. Sujan, V. A. and Dubowsky, S. *Metric based dynamic parameter identification for mobile field manipulator systems.* Proceedings of the ASME 27th Biennial Mechanisms and Robotics Conference, September 29 – October 2, 2002, Montreal, Canada. Nominated/finalist for best conference paper.
15. Sujan, V. A. *Optimum Camera Placement by Robot Teams in Unstructured Field Environments*. Proceedings of the IEEE International Conference on Image Processing (ICIP), September 22-25, 2002, Rochester, New York.
16. Sujan, V. A. *Using segmented Fourier-Hankel preprocessing and the HAVNET neural network for Fingerprint identification*. Proceedings of the 6th World Multi-Conference on Systemics, Cybernetics and Informatics. International Institute of Informatics and Systemics. SCI/ISAS 2002. July 14-18, 2002. Orlando, Florida USA.

17. Sujan, V. A. *Task Directed Imaging in Unstructured Environments by Cooperating Robots.* Proceedings of the 2002 Third Indian Conference on Computer Vision, Graphics and Image Processing, December 16-18, 2002, Ahmedabad, INDIA
18. Huntsberger, T., Sujan, V. A., Dubowsky, S., Schenker, P. *Integrated System for Sensing and Traverse of Cliff Faces.* Proceedings of the 2003 SPIE's 17th Annual International Symposium on Aerospace/Defense Sensing, Simulation, and Controls: Symposium on Unmanned Ground Vehicle Technology V. April 21-24, Orlando, Florida USA.
19. Sujan, V. A. and Meggiolaro, M. A. *Improving the positioning accuracy of robotic manipulators subject to base oscillation.* Proceedings of the 2003 Brazilian Society of Mechanical Sciences and Engineering (ABCM), 17th International Congress of Mechanical Engineering, São Paulo, Brazil, 10-14 November, 2003
20. Schenker, P., Huntsberger, T., Pirjanian, P., Dubowsky, S., Iagnemma, K., and Sujan, V. *Rover Control for Intelligent and Agile Traverse of Challenging Terrain.* Invited session paper in the Proceedings of the IEEE 11th International Conference on Advanced Robotics (ICAR), June 30 - July 3, 2003, University of Coimbra, Portugal.
21. Sujan, V. A., Dubowsky, S., Huntsberger, T., Aghazarian, H., Cheng, Y. and Schenker, P. *Multi Agent Distributed Sensing Architecture with Application to Cliff Surface Mapping.* Proceedings of the 11th International Symposium of Robotics Research (ISRR), October 19-22, 2003, Siena, Italy.
22. Sujan, V. A. *Visually Guided Object Insertion by Cooperative Robots in Unstructured Environment.* Proceedings of the ASME 28th Biennial Mechanisms and Robotics Conference, September 28 – October 2, 2004, Salt Lake City, Utah.
23. Sujan, V. A. *Visually Guided Object Insertion by Cooperative Robots in Unstructured Environment.* Robotics Today. 3rd Quarter 2005, Volume 18, No. 3. Society of Manufacturing Engineers (SME) Automated Manufacturing & Assembly.
24. Sujan, V. A. *Information-based Visual Robotic Mapping in Unstructured Environments*. Proceedings of the 2004 8th World Multi-Conference on Systemics, Cybernetics and Informatics. International Institute of Informatics and Systemics. SCI/ISAS 2002. July 18-21, 2004. Orlando, Florida USA
25. Scofano, F.S., Meggiolaro, M.A., Sujan, V.A. *Inverse Kinematics of a Binary Flexible Manipulator Using Genetic Algorithms*. 18th Brazilian Congress on Mechanical Engineering (COBEM), Mechatronics Symposium (ABST1162), ABCM, Ouro Preto, MG, Brazil, 2005.
26. Sujan, V.A., Belo, F.A.W., Meggiolaro, M.A. *Mobile Robot Localization and Mapping Using Space Invariant Transforms*. 18th Brazilian Congress on Mechanical Engineering (COBEM), Mechatronics Symposium (ABST1152), ABCM, Ouro Preto, MG, Brazil, 2005.
27. Sujan, V.A., Meggiolaro, M.A., Belo, F.A.W. *Mobile Robot Simultaneous Localization and Mapping Using Low Cost Vision Sensors*. International Symposium of Experimental Robotics, ISER '06, Rio de Janeiro, Brazil, July 6-10, 2006.
28. Sujan, V.A., Meggiolaro, M.A., Belo, F.A.W. *Mobile Robot Simultaneous Localization and Mapping Using Low Cost Vision Sensors*, in Experimental Robotics (ISBN 978-3-540-77456-3), Springer Tracts in Advanced Robotics (STAR), pp.259-266, 2008.
29. Eckerle, W., Sujan, V.A., Salemme, G. *Future Challenges for Engine Manufacturers in View of Future Emissions Legislation*. 9th AVL/SAE International Commercial Powertrain Conference, May 10 – 11, 2017, Messe Congress Graz, Austria.
30. Guerrero de la Peña, A., Davendralingam, N., Raz, A. K., Sujan, V., DeLaurentis, D., Shaver, G., Jain, N., *Modeling Freight Transportation as a System-of-Systems to Determine Adoption of Emerging Vehicle Technologies*, International Conference on Transportation and Development (ICTD), Pittsburgh, July 15-18, 2018
31. A. Guerrero de la Peña, N. Davendralingam, A. Raz, G. Shaver, D. DeLaurentis, Vivek A. Sujan, and N. Jain *Modeling the Combined Effect of Powertrain Options and Autonomous Technology on Vehicle Adoption and Utilization by Line-haul Fleets*. *Proceedings of the 2019 IEEE Intelligent Transportation Systems Conference, Auckland, New Zealand, October 27-30*, 2019.
32. Chadha, P., and Sujan, V.A. *Quantification of Platooning fuel economy benefits across US interstates using closed loop vehicle model simulation*. SAE Technical Papers 20NETP-0086R2

Thesis

1. Sujan, V. A. *The sensor based manipulation of irregularly shaped objects with special application to the semiconductor industry*. Master of Science in Mechanical Engineering thesis June 1998, Dept. of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA. U. S. A.
2. Sujan, V. A. *Compensating for Model Uncertainty in the Control of Cooperative Field Robots*. Ph. D. thesis June 2002, Dept. of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA. U. S. A.

U.S. Patents granted:

1. **7,650,218** Apparatus, system, and method for preventing turbocharger overspeed in a combustion engine
2. **7,650,224** Apparatus, system, and method for reducing nitrogen oxide emissions in a combustion engine
3. **7,757,549** Apparatus, system, and method for predictive control of a turbocharger
4. **7,769,522** Apparatus and method for preventing an underspeed event of a turbocharger
5. **7,770,565** System and method for controlling an exhaust gas recirculation system
6. **7,805,235** System and method for controlling a flow of intake air entering an internal combustion engine
7. **7,861,580** Virtual turbine speed sensor
8. **8,001,783** Apparatus, system, and method for turbocharger bypass and exhaust braking with a single valve
9. **8,302,385** Apparatus, system, and method for controlling engine exhaust temperature
10. **8,392,057 (CN 102470778 A ZL 201080031382.4)** Hybrid powertrain diagnostics
11. **8,452,509** System and method of vehicle speed-based operational cost optimization
12. **8,509,974** Hybrid power train rate control
13. **8,516,806** Control of aftertreatment regeneration in a hybrid powered vehicle
14. **8,549,838** System, method, and apparatus for enhancing aftertreatment regeneration in a hybrid power system
15. **8,577,568** Supervisory thermal management system and method for engine system warm up and regeneration
16. **8,639,403** Modularized hybrid power train control
17. **8,639,436** System and method of vehicle fuel quantity management
18. **8,676,455** Methods and systems for selecting or maintaining an efficient gear or gear ratio
19. **8,677,748** Fresh air flow estimation
20. **8,688,302** Hybrid power system braking control
21. **8,731,788** System and method of speed-based downspeed coasting management
22. **8,742,701 (CN 103261617 201180061446.X)** System, method, and apparatus for integrated hybrid power system thermal management
23. **8,781,664** System, method, and apparatus for controlling power output distribution in a hybrid power train
24. **8,790,215** System, method, and apparatus for controlling power output distribution in a hybrid power train
25. **8,818,659** Supervisory thermal management system and method for engine system warm up and regeneration
26. **8,821,342 (CN 103384760 ZL201180068710.2)** Accessory drive motor configuration
27. **8,833,496** System, method, and apparatus for battery pack thermal management
28. **8,834,318** System, method, and apparatus for controlling power output distribution in a hybrid power train
29. **8,845,483** System, method, and apparatus for controlling power output distribution in a hybrid power train
30. **8,852,051** System, method, and apparatus for controlling power output distribution in a hybrid power train
31. **8,852,052** System, method, and apparatus for controlling power output distribution in a hybrid power train
32. **8,869,512** Combined engine out NOX management
33. **8,886,422** System and Method of Cylinder Cutout for Optimal Engine Torque-Speed Map Operation
34. **8,888,652** System, method, and apparatus for controlling power output distribution in a hybrid power train
35. **8,965,613** System, method, and apparatus for controlling power output distribution in a hybrid power train
36. **8,997,353** Apparatus, system, and method for shaping a valve orifice
37. **9,043,060** Methods, Systems, and Apparatuses for Driveline Load Management
38. **9,043,061** Methods, Systems, and Apparatuses for Driveline Load Management
39. **9,086,025** Systems and methods for correcting mass airflow sensor drift
40. **9,090,250** System, method, and apparatus for battery pack thermal management
41. **9,103,294** Fuel drift estimation and compensation for operation of an internal combustion engine
42. **9,109,546** System and method for operating a high pressure compressor bypass valve in a two stage turbocharger system
43. **9,140,203** Apparent plumbing volume of air intake and fresh airflow value determination
44. **9,162,679** System and Method of Vehicle Operating Condition Management
45. **9,175,970** Online Optimal Refueling Management

46. **9,182,764** Apparatus and method for grouping vehicles for cooperative driving
47. **9,187,093** Cruise Droop/Active Vehicle Speed Management Modification Concepts
48. **9,194,309** Real time route identification using a low cost GPS measurement for optimal vehicle powertrain management
49. **9,194,318** System and method of DPF passive enhancement through powertrain torque-speed management
50. **9,206,756** Closed loop NO_X reference management for DPF regeneration based on engine out particulate matter variation controller
51. **9,228,460** Systems and methods for thermal management of aftertreatment system components
52. **9,228,511** Engine feedback control system and method
53. **9,235,817** System and method of determining freight/load distribution for multiple vehicles
54. **9,243,541** Control of aftertreatment regeneration in a hybrid powered vehicle
55. **9,272,621** Systems and Methods for Vehicle Speed Management
56. **9,297,325** Systems and methods for compensating airflow determinations for air compressor bleed
57. **9,316,195** Systems and Methods for Optimization and Control of Internal Combustion Engine Starting
58. **9,340,202** Engine start/stop function management and control architecture
59. **9,347,401** Lambda feedback control for robust particulate emissions performance
60. **9,353,696** Combustion controller for internal combustion engine
61. **9,440,635** System and method of speed-based downspeed coasting management
62. **9.541,039** Apparatus, system, and method for reducing emissions of nitrogen oxides
63. **9,551,993** Apparatus and method for grouping vehicles for cooperative driving
64. **9,586,573** System and Method for Determining Smart Torque Curve Optimizing User Performance
65. **9,624,857** System and method of DPF passive enhancement through powertrain torque-speed management
66. **9,636,997** System, Methods, and Apparatus for Engine Cooling System Management
67. **9,650,042** Systems and Methods for Route Planning
68. **9,658,077** Online optimal refueling management
69. **9,694,826** Vehicle Controls for Determining Optimal Gear Shifting Opportunities Using Dynamically Determined Vehicle Parameters
70. **9,707,968** Powertrain Controls Including Transient Torque Management with Dynamic Release Compensation
71. **9,709,014** Method of Optimization, Control and Synchronization of Cranking Process of an Internal Combustion Engine
72. **9,725,091** Vehicle Speed Management Integrated with Vehicle Monitoring System
73. **9,725,093** Vehicle Controls Including Dynamic Vehicle Mass and Road Grade Estimation During Vehicle Operation
74. **9,802,597** System and Method for Vehicle Transient Torque Management
75. **9,821,663** Systems and Methods for Battery Regeneration Based on Engine Loading
76. **9,828,904** Apparatus, system and method for shaping a valve orifice
77. **9,835,099** Engine feedback control system and method
78. **9,835,248** Systems and methods for dynamic gear state and cruise speed management
79. **9,851,722** Apparatus and method for grouping vehicles for cooperative driving
80. **9,868,432** Vehicle Coasting Systems and Methods
81. **9,909,517** Multi-Mode Controls for Engines Systems Including SCR Aftertreatment
82. **9,989,147** Using Vehicle/Road Load Power Estimation to Compensate Transmission Shift Schedule
83. **10,000,197** Mild Torque Assist Electric Motor/Generator Torque offset Real-Time Correction
84. **10,000,214** Vehicle Controls Including Dynamic Vehicle Parameter Determination
85. **10,001,070** Multi-fuel engine controls including multi-factor cost optimization
86. **10,023,188** Systems and Methods for Pre-Hill Cruise Speed Adjustment
87. **10,029,693** Active acceleration limit management and gear shift scheduling based on driving environment
88. **10,030,764** Powertrain Optimization
89. **10,081,355** System, method, and apparatus for controlling power output distribution in a hybrid power train

90. **10,093,299** Route-Vehicle road load management and/or operator notification thereof
91. **10,094,308** System, method, and apparatus for improving the performance of an operator of a vehicle
92. **10,113,637** Powertrain Optimization – Engine Transmission Integration Options
93. **10,197,156** Systems and methods for dynamic gear state and vehicle speed management
94. **10,300,831** Hybrid Reefer Systems
95. **10,302,025** Systems and Methods for Cylinder Deactivation with Deactivated Cylinder Pressure Control
96. **10,328,923** System and Method for Vehicle Transient Torque Management
97. **10,351,138** Active Prognostics and Diagnostics of Rotary Engine Driven Accessories with Intermittent Duty Cycle
98. **10,393,195** Optimization of concurrent operation of predictive cruise control and idle coast management control
99. **10,435,007** Energy management and control of electrified powertrain using eHorizon and telematics information
100. **10,579,953** System and Method of Determining Freight/Load Distribution for Multiple Vehicles
101. **10,676,077** Energy management and control of electrified powertrain using eHorizon and telematics information
102. **10,710,586** Systems and methods for idle coasting management
103. **10,717,440** Driveline disengagement and coasting management
104. **10,788,845** Optimization of Mission Efficiency Through Platoon Opportunity Assessment
105. **10,793,134** Vehicle Coasting Systems and Methods
106. **10,808,670** Engine stop/start enablement based on combustion parameters
107. **10,865,877** Powertrain optimization
108. **10,894,482** Systems and Methods of Battery Management and Control for a Vehicle
109. **10,935,127** Systems and Methods for Predictive Gear Shifting and Integrated Predictive Cruise Control
110. **10,943,490** Platoon Systems for Vehicles
111. **10,960,884** Driveline Disengagement and Coasting Management
112. **10,988,140** Optimization of concurrent operation of predictive cruise control and idle coast management control
113. **11,035,263** Compression release valvetrain design

International Patents granted:

1. **CN102470778** Hybrid powertrain diagnostics
2. **CN102529738** System, method, and apparatus for battery pack thermal management
3. **CN102717794** Modularized hybrid power train control
4. **CN103052781** Hybrid power train rate control
5. **CN103154452** Control of aftertreatment regeneration in hybrid powered vehicle
6. **CN103261617** System, method, and apparatus for integrated hybrid power system thermal management
7. **CN103299037** System, method and apparatus for enhancing aftertreatment regeneration in a hybrid power system
8. **CN103384760** Accessory drive motor configuration
9. **CN103402809** System, method, and apparatus for controlling power output distribution in hybrid power train
10. **CN104769262** Control methods of internal combustion engine starting
11. **CN105599768** Vehicle controls including dynamic vehicle mass and road grade estimation during vehicle operation
12. **CN106164452** Fast engine synchronization for restart management
13. **CN108883734** Systems and methods of energy management and control of vehicle accessories
14. **CN109072858** Engine stop/start enablement based on combustion parameters
15. **CN109843674** Dynamic torque management techniques for enhanced engine cycle efficiency
16. **CN109927724** Optimization of concurrent operation of predictive cruise control and idle coast manegement control
17. **CN110023160** Systems and methods for controlling a hybrid engine system
18. **CN110225854** Systems and methods for predictive gear shifting and integrated predictive cruise control
19. **CN110799371** Dynamic accelerator response management for a vehicle

20. **CN111727467** Interface for engine controller and platooning controller
21. **DE102013001608** Method for compensating airflow determinations for air compressor bleed of pressurized intake air in vehicle diesel engine, involves determining flow estimate for one of two portions of pressurized airflow in response to flow parameter
22. **DE112012001015** System und Verfahren der DPF-passiven Verstärkung durch Antriebsstrang-Drehmoment-Geschwindigkeitsmanagement
23. **DE102013016801** Method for determining lambda error and/or nitrogen oxide error for controlling e.g. exhaust gas recirculation portion for internal combustion engine, involves controlling exhaust gas recirculation portion in response to output signal
24. **DE102012007142** Kombiniertes Motor-Ausstoß-N0x-Management
25. **DE112012001021** System und Verfahren der Zylinderdeaktivierung für einen optimalen Motordrehmoment-Geschwindigkeit-Kennfeld-Betrieb
26. **DE112011104561** Vorrichtung und Verfahren zur Verwaltung eines Fahrzeugbetriebszustandes
27. **DE112011103888** System, Verfahren und Vorrichtung für ein integriertes Thermomanagement in einem Hybridantriebssystem
28. **DE112012000459** System und Verfahren zur Ermittlung der Fracht-/Beladungsverteilung für mehrere Fahrzeuge
29. **DE112011102914** Steuerung zur Regeneration einer Nachbehandlungseinrichtung in einem Fahrzeug mit Hybridantrieb
30. **DE112007003112** Verfahren, Systeme und Vorrichtungen zur AGR-Steuerung
31. **DE112011104550** System und Verfahren zur fahrzeuggeschwindigkeitsbasierten Betriebskostenoptimierung
32. **DE102010005099** Bypassventilbetätigung
33. **DE112008002528** Vorrichtung, System und Verfahren zur Verhinderung von Turbolader-Überdrehzahlen in einer Brennkraftmaschine
34. **DE112016006623** Motorstopp-/Startaktivierung basierend auf Verbrennungsparametern
35. **DE112011104498** Vorrichtung und Verfahren zur geschwindigkeitsbasierten Geschwindigkeitsverringerungs-Ausroll-Verwaltung
36. **DE112012000447** System und Verfahren eines Kraftstoffquantitätsmanagements eines Fahrzeugs
37. **DE102015001818** Fahrwiderstandsmanagement für Landfahrzeuge und/oder diesbezügliche Bedienerbenachrichtigung
38. **DE212014000080** Apparatus and system for reducing the number of ignition knocking in the case of an internal combustion engine
39. **EP2341246** Method and system for monitoring operation of a wind farm
40. **EP2661388** Supervisory thermal management system and method for engine system warm up and regeneration
41. **EP2659106** Accessory drive motor configuration
42. **EP2516207** Hybrid powertrain diagnostics
43. **EP2314866** Wind turbine blade with foreign matter detection devices
44. **EP3548350** Systems and methods for controlling a hybrid engine system
45. **EP3126655** Fast engine synchronization for restart management
46. **EP2609316** Hybrid power train rate control
47. **EP3548716** Compression release valvetrain design
48. **EP2663480** System, method, and apparatus for controlling power output distribution in a hybrid power train
49. **EP3529119** Dynamic torque management techniques for enhanced engine cycle efficiency
50. **EP3386804** Systems and methods of energy management and control of vehicle accessories
51. **WO2019074478** Autonomous safety systems and methods for vehicles
52. **WO2019152054** System and method for tractor trailer dynamic load adjustment
53. **WO2019005654** Dynamic accelerator response management for a vehicle
54. **WO2009146452** Apparatus, system, and method for controlling engine exhaust temperature
55. **WO2016022095** Road grade prediction based on current and previous grade history
56. **WO2009094650** Apparatus, system, and method for turbocharger bypass and exhaust breaking with a single valve
57. **WO2020139814** Systems and methods for controlling overtake maneuver in vehicles
58. **WO2012118858** System and method of dpf passive enhancement through powertrain torque-speed management
59. **WO2014158709** Method and apparatus for reducing knock in an internal combustion engine
60. **WO2012021674** Thermal control of a hybrid power train using shape memory alloys

61. **WO2012094646** Supervisory thermal management system and method for engine system warm up and regeneration
62. **WO2019089749** Control of vehicle platoon systems in response to traffic and route conditions
63. **WO2012092568** Accessory drive motor configuration
64. **WO2009108710** Apparatus, system, and method for reducing nitrogen oxide emissions in a combustion engine
65. **WO2011079100** Hybrid powertrain diagnostics
66. **WO2018140366** Systems and methods for predictive gear shifting and integrated predictive cruise control
67. **WO2012088537** System and method of vehicle operating condition management
68. **WO2012088106** System, method, and apparatus for integrated hybrid power system thermal management
69. **WO2018102428** Systems and methods for controlling a hybrid engine system
70. **WO2015152866** Engine stop position sensing synchronization through engine stop location estimation
71. **WO2016064712** Systems and methods for battery regeneration based on engine loading
72. **WO2015153029** Closed loop nox reference management for dpf regeneration based on engine out particulate matter variation controller
73. **WO2015153448** Fast engine synchronization for restart management
74. **WO2018102542** Compression release valvetrain design
75. **WO2017023898** Systems and methods of energy management and control of an electrified powertrain
76. **WO2008082540** Methods systems and apparatuses of egr control
77. **WO2018081062** Dynamic torque management techniques for enhanced engine cycle efficiency
78. **WO2013082004** Fuel drift estimation and compensation for operation of an internal combustion engine
79. **WO2012118865** System and method of cylinder deactivation for optimal engine torque-speed map operation
80. **WO2019118833** Interfaces for engine controller and platooning controller
81. **WO2011153486** Fresh air flow estimation
82. **WO2012027136** Hybrid power train rate control
83. **WO2012088534** System and method of vehicle speed-based operational cost optimization
84. **WO2012088536** System and method of speed-based downspeed coasting management
85. **WO2012054614** System, method and apparatus for enhancing aftertreatment regeneration in a hybrid power system
86. **WO2012097200** System and method of determining freight/load distribution for multiple vehicles
87. **WO2017027332** Systems and methods of battery management and control for a vehicle
88. **WO2010075532** An apparatus and method for providing thermal management of a system
89. **WO2020061525** Power charging control systems and methods for electric vehicles
90. **WO2010008848** Virtual turbine speed sensor
91. **WO2018106575** Multi-vehicle load delivery management systems and methods
92. **WO2009039511** Apparatus, system, and method for preventing turbocharger overspeed in a combustion engine
93. **WO2012054619** Control of aftertreatment regeneration in a hybrid powered vehicle
94. **WO2017204805** Engine stop/start enablement based on combustion parameters
95. **WO2012097349** System, method, and apparatus for controlling power output distribution in a hybrid power train
96. **WO2012097184** System and method of vehicle fuel quantity management
97. **WO2014070529** Control methods of internal combustion engine starting
98. **WO2012092400** Hybrid power system braking control
99. **WO2015138286** Engine start/stop function management and control architecture
100. **WO2019046182** Intrusive diagnostics and prognostics using cycle efficiency management
101. **WO2017100613** Systems and methods of energy management and control of vehicle accessories
102. **WO2017024217** Mine haul truck performance metric management system ans method
103. **WO2019032568** Route parameter manager system