# Biodata of Dr.Somnath Sengupta, ATDC

1. **Name in Full :** SOMNATH SENGUPTA
2. **Designation :** Assistant Professor, Indian Institute of Technology Kharagpur
3. **Date of Joining the Institute :** 11th October 2017
4. **Type of employment:** Regular/Permanent
5. **Education:**
   –PhD in Electrical Engineering, Indian Institute of Technology Kharagpur
   –M.Tech in Energy Systems Engineering, Indian Institute of Technology Bombay
   –B.Tech in Electrical Engineering, C.E.T. (State Govt. of Orissa, India)
6. **Industrial project Experience:** More than 15 years of Industrial R&D experience in working with various engineering organizations
   **Companies worked for:** CMC Ltd. (R&D, Embedded systems Group), Ericsson (Sweden), EATON Electricals (USA), MKSI(USA), Shweeb Monorail (New Zealand), General Motors (R&D), ARAI (R&D), KPIT Technologies Ltd. (R&D)
7. **Awards:**
   –WOW Award KPIT (R&D)
   –Innovator @ KPIT (2 awards)
   –Special Recognition Award (TCS-Ericsson)
   –OUAT merit scholarship during Bachelors Engineering
8. **Teaching at IIT Kharagpur:** Have been teaching the following courses and labs:
   **(a) Courses:**
   (i) AT60001: Embedded Control Systems
   (ii)AT60002: Principles of Automotive Dynamics and Control (Also created/floated this subject)
   (iii)AT30001: Fundamentals of Embedded Control and Software
   **(b) Labs:**
   (i) AT69001: Embedded Control Laboratory
   (ii) AT69002: Embedded Applications Laboratory
   (iii) DY17003: DIY Project (Lab)
9. **Student Guidance:**

   - Ph.D. students: 2 (Ongoing)
   - MTech : 5 (guided)
   - BTech : 8 (guided)

**10. Relevant Publications/Patents:**

**(A) Journal Papers**

(i) Shandilya, A., Pandey, S., Sengupta, S., Melby, G. et al., "Improving Performance of Heating, Ventilation, and Air-Conditioning System of Electric Vehicle Using Evaporative Cooling: A Model-Based Analysis," *SAE J. STEEP* 2(2):191-203, 2021, https://doi.org/10.4271/13-02-02-0012.

(ii) Janbandhu, S., Sengupta, S., Mukhopadhyay, S., and Sarkar, P., "Model Predictive Control-based Engine Idle Speed Regulation with Various Coordinated Controls Using an Instantaneous Engine Model," *SAE Int. J. Engines* 14(4):517-530, 2021, https://doi.org/10.4271/03-14-04-0031.

(iii) Dhrupad Biswas, Susenjit Ghosh, Somnath Sengupta, Siddhartha Mukhopadhyay,

"Energy Management of a Parallel Hybrid Electric Vehicle using Model Predictive Static Programming", *Energy*, Volume 250, 2022, https://doi.org/10.1016/j.energy.2022.123505

(iv) S. Sengupta, S. Mukhopadhyay, A. K. Deb and K. Pattada, "Estimation of Within Cycle Dynamics of an SI Gasoline Engine Using Equivalent Cycle Reconstruction," in *IEEE Transactions on Instrumentation and Measurement*, vol. 63, no. 8, pp. 2072-2092, Aug. 2014, doi: 10.1109/TIM.2014.2302241.

(v) Sengupta, S., Deb, A., and Mukhopadhyay, S., "Diagnosis of Within Cylinder Faults using Instantaneous Mode based Engine model ," SAE Int. J. Engines9(2):2016.

(vi) Sengupta, S., Mukhopadhyay, S., Deb, A., Pattada, K. and De, S., "Hybrid Automata Modeling of SI Gasoline Engines towards State Estimation for Fault Diagnosis," *SAE Int. J. Engines* vol.5, no.3, pp.759-781, 2012, doi: 10.4271/2011-01-2434.

## (B) Patents:

(i) **Granted:** S. De, P. Kallappa, P. Bandyopadhyay, S. Mukhopadhyay, S. Sengupta and A. K. Deb, "State estimation diagnosis and control using equivalent time sampling," U.S. Patent 8 751 097, June 10, 2014.

(ii) **Patent 1 filed for PCT:** "Model Predictive based control for automobiles", WIPO (PCT): Ref: WO2018104850A1 (https://patents.google.com/patent/WO2018104850A1/en)

(iii) **Patent 2 filed** for **PCT**: "PREDICTIVE ENERGY MANAGEMENT AND DRIVE ADVISORY SYSTEM FOR PARALLEL HYBRID ELECTRIC VEHICLES", PCT International Application No. PCT/IB2022/052213, Filing Date: 11-03-2022

(iv) **Patent 3 filed (Indian)** (Provisional): "Integrated motor control unit and vehicle control unit for low speed electric vehicle", **Application number:** 202131038017, filed: 23rd August 2021.

## (C) Conference papers:

(i) Dhrupad Biswas, Somnath Sengupta, Desham Mitra, Siddhartha Mukhopadhyay, "Improved Energy Management Strategy of Hybrid Electric Vehicles with Varying Terrain", IFAC-PapersOnLine, Volume 51, Issue 31, 2018, Pages 618-625, ISSN 2405-8963, Changchun, China.

(ii) D. Biswas, S. Ghosh, S. Sengupta and S. Mukhopadhyay, "A Predictive Supervisory Controller for an HEV Operating in a Zero Emission Zone," 2019 IEEE Transportation Electrification Conference and Expo (ITEC), Detroit, MI, USA, 2019, pp. 1-6.

(iii) S. Srivastava, P. Maheshwari and S. Sengupta, "Automated Generation of Energy Efficient Drive Cycles for Electric Vehicles Considering Limiting Factors," 2019 4th International Conference on Robotics and Automation Engineering (ICRAE), IEEE, Singapore, Singapore, 2019, pp. 104-110

(iv) Tarun Karak, Somnath Sengupta, Sudip Nag, "Reference Trajectory Generation for Closed-Loop control of electrical stimulation for Rehabilitation of upper limb", IFAC 2020, Berlin, Germany

(v) Susenjit Ghosh, Dhrupad Biswas, Desham Mitra, Somnath Sengupta, Siddhartha Mukhopadhyay "Effect of Uncertainty in SOC Estimation on the Performance of Energy Management for HEVs", IFAC 2020, Berlin, Germany

(vi) Simran Kumari, Susenjit Ghosh, Desham Mitra, Somnath Sengupta, Siddhartha Mukhopadhyay "Collision Risk Assessment based on Line of Sight", IFAC 2020, Berlin, Germany

(vii) Siddharth Lakhera, Somnath Sengupta, Vimlendu Singh "Model Predictive Controller Development for controlling Actuators of Automated Manual Transmission", IFAC 2020, Berlin, Germany

(viii) Goel, A. and Sengupta, S., "Basic Autonomous Vehicle Controller Development through Modeling and Simulation," SAE Technical Paper 2018-01-0041, 2018, Michigan, USA.

(ix) S. Lakhera, A. Mishra and S. Sengupta, "Fault Tolerant Control of Electric Vehicles with Transmission Fault," *2019 IEEE 5th International Conference for Convergence in Technology (I2CT)*, Bombay, India, 2019, pp. 1-7.

(x) K. Chauhan, A. Kumar, K. K. Ramakrishna Pandian, S. Sengupta and T. Q. Dinh, "Brake Control of a Two-wheeler using Optimal Slip Prediction based Sliding Mode Control," 2021 24th International Conference on Mechatronics Technology (ICMT), 2021, pp. 1-6.

(xi) S. Ghosh, D. Biswas, D. Mitra, S. Sengupta and S. Mukhopadhyay, "Effect of SOC Uncertainty on MPC based Energy Management Strategy for HEVs," 2020 IEEE 17th India Council International Conference (INDICON), 2020, pp. 1-6.

(xii) Sengupta, S., De, S., Bhattacharyya, A.K., Mukhopadhyay, S., Deb, A.K., "Fault detection of Air Intake Systems of SI gasoline engines using mean value and within cycle models," *IEEE* International Conference on Automation Science and Engineering (CASE), pp.361-366, 22-25 Aug., 2009.
(xiii) Sengupta, S., Mukhopadhyay, S., Deb, A.K., "Instantaneous within cycle model based fault estimators for SI engines," IEEE Annual India Conference (INDICON), pp.1-6, 16-18 Dec. 2011.
(xiv) Vasu, J.; Sengupta, S., Deb, A.K.; Mukhopadhyay, S., "Development of extended MVEM based fault residue generators using UKF state observers," IEEE Annual India Conference (INDICON), pp.1-6, 16-18 Dec. 2011.
(xv) Sengupta, D., Sengupta, S., Mukhopadhyay, S., "Estimation of instantaneous states of an SI gasoline engine using EKF and UKF," IEEE Annual India Conference (INDICON), pp.1-6, 16-18 Dec. 2011.
(xvi) V. Mathew, S. Sengupta, M. Chatterjee and S. Kamath, "Sensor health monitoring using simple data driven approaches," Indian Control Conference (ICC),Hyderabad,India,2016,pp.32-38.
(xvii) Ranadive, P., Sengupta, S., SS, N., Boggarapu, N.,Vaidya, V., "Taxonomy of Automotive Real-Time Scheduling"SAE World Congress and Exhibition, Detroit, USA, 2016.
(xviii) Chandrasekar, A., Sengupta, S., Hingane, S., Gururaja, C. et al., "Comparative Analysis of Model Predictive Control (MPC) and Conventional Control in Supervisory Controller of a Retrofit HEV," SAE Technical Paper 2017-26-0093, 2017.
(xix) Sengupta, S.,Gururaja, C.,Hingane, S., et al., "Evaluation of Model Predictive and Conventional Method Based Hybrid Electric Vehicle Supervisory Controllers", SAE World Congress, Detroit, Michigan, USA April 4-6, 2017

**11. Projects (Sponsored Project/Consultancy) at IIT Kharagpur:**

(a) Modeling, Simulation, Fault Detection and Diagnosis of Permanent Magnet Synchronous Machines (project code: MSFD) with **EATON Innovation Centre, India** (Consultancy) (Completed) (Role: PI)
(b) Development of a Laboratory on Novel Electronics Control and Software for Transport By EV (NECST-EV) (Project code: CNE_OTG) (Research Project)-Project has been completed (Role: Co-PI)
(c) Fault Tolerant Control Strategies for Electric Vehicles (Project Code: FTV) (**ISIRD** project) (Role: PI)
(d) "Open and Intelligent Plug-in Hybrid Electric Vehicle (PHEV) Technologies for Smart Indian Cities under the Indian Government's Uchchatar Avishkar Yojana (UAY-Sponsored by **TATA Motors** & **MHRD**) Scheme (Research project) (Project Code: HEV) (Was involved in the project from November 2017 to August 2020) (Role: Co-PI)
(e) Development of Indigenous Electrical Sub-Systems for 3-Wheeler E-Rickshaw Along with a Smart Vehicle Control Unit (Research project sponsored by **Ministry of Electronics and Information Technology, Govt. of India**) (Role: PI)
(f) Indigenous Development and Commercialization of Advanced Lightweight and Efficient Powertrain for Electric 3-wheelers (Research project sponsored by **Ministry of Electronics and Information Technology, Govt. of India**) (Role: Co-PI)

**12. Details of some past industrial experience:**

1) Before joining IIT Kharagpur as an Assistant Professor, I was working as a Subject Matter Expert (Control Systems) at CTO (R&D), **KPIT Technologies Ltd**. Involved in evaluating innovative engineering ideas of the company and working on model and controller development of an actual HEV as well as modelling and simulation of EV power system of an actual EV bus for fault analysis

**Major Projects Handled at KPIT Technologies Ltd**.

• Development of Model Predictive Control Strategy for Hybrid Electric Vehicles (both simulation and actual vehicle)

• Complete Simulation Model of actual EV and HEV

• Development of Novel and efficient Scheduling algorithms for periodic and non-periodic tasks for Autosar, etc

• Complete analysis of Engine Model for **Cummins**

• Detailed Modelling and Simulation of EV's power system for fault analysis

2) Prior to KPIT Technologies, worked in Automotive Electronics Department at **ARAI** (Automotive Research Association of India, under **Ministry of Heavy Industries**, **Government of India**) as **Deputy Manager (R&D)** in the area of electric and hybrid electric vehicle's model-based development as well as building strategies for gasoline direct injection (GDI)

**Highlights of Work at ARAI**

• Led operations for Automotive Electronics Department in the area of electric and hybrid electric vehicle development as well as building control strategies for gasoline direct injection (GDI) engines.

• Handled the gamut of operations as

- o Choosing and procurement of components of electric vehicle.
- o Testing of performance of motor to suit EV requirements.
- o Modelling of electric vehicle components and architecture.
- o Development of EV and data acquisition for the same.
- o Modelling of Powertrain of car

• Conducted extensive study and development of control strategies for GDI and benchmarking with real engine.

**Major Projects Handled at ARAI**

• Development of Electric and Hybrid Electric Vehicle Simulator: Building library blocks for components of electric and hybrid electric vehicle using MATLAB/SIMULINK.

• Development of actual Small Commercial Electric Vehicle for public transport: Integration of different components of an electric vehicle such as battery, inverter, motor, transmission tuning the performance to suit the requirement. This also involved testing of motor in dynamometer for characterizing the motor performance.

• Development of control strategy for Gasoline Direct Injection (GDI); Building different control strategies of GDI and incorporating them in HILs platform to evaluate their performance in real time and benchmarking with existing GDI car engine (Ford EcoSport).