Curriculum Vitae

Manoranjan Sinha
Professor
Department of Aerospace Engineering, IIT Kharagpur
Specialization: Space Flight Mechanics
B.Tech. (IITD-1993), M. Tech., Ph. D. (IITK-1996,2001)
Post Doctoral Fellow, University of Saskatchewan, Canada

Teaching Experience

Space Dynamics, Flight Mechanics, Flight Stability & Control, Automatic Control of Aircraft, Introduction to Flight Vehicle Control, Flight Vehicle System Identification, Advanced Flight Mechanics, Neural Networks, Flight Mechanics Lab, Systems Lab**,** Aerodynamics Lab, Neuro-Fuzzy control (IITKGP, IITB)

MOOCS/NPTEL COURSES

- Space Flight Mechanics (Elementary)
- Space Flight Mechanics (Advance)
- Satellite Attitude Dynamics and Control

Recent Projects

- Loss of Control Characterization and Reconfigurable Control of Aircraft (HAL)

Some Important Research Contributions

- The Lorentz force actuated satellite attitude control was introduced and proved that such a system is controllable for arbitrarily high angular velocity. Control of magnetically actuated or the Lorentz force actuated satellite for arbitrarily high angular velocity was an unsolved problem for the last six decades which was addressed in the above mentioned work.
- Comprehensive fighter aircraft dynamics was modeled for the sudden change in the C.G. due to the asymmetric firing of missile. The effect of reaction from the missile due to faulty firing was studied comprehensibly. Herbst and cobra maneuvers were carried out (simulation) in such a condition through two new control designs.
- The magnetic torquer actuated satellite with only two magnetic torquers, which did not have a direct proof of controllability and was an unsolved terminal problem was solved explicitly. This work is of immense practical utility for small satellites which do not have any back up for attitude control. This was the best read paper in 2011-2012.

- Rendered the parameter estimation using neural network amenable to theoretical studies and established it as a better method for noise contaminated data. This has opened the theoretical field for establishing the neural network for the parameter estimation with vast scope of work.

- Development of autonomous air vehicle with reconfiguration capability which obtained first prize in Mahindra Satyam Young Engineer's Award.

Awards/Honor/Others

- Excellent reviewer AIAA JGCD (2017)
- Outstanding Reviewer , Aerospace Science and Technology, Elsevier (June 2018)
- Vikram Award for Systems (2010)
- Subject Award- Institution of Engineers (2010)
- My team got first prize in Mahindra Satyam Young Engineers Prize (2010)
- President of India Gold Medal, Institution of Engineers India (2013)
- Best downloaded paper 2011-12

Reviewer:

Journal of Applied soft computing (Elsevier), Journal of Aerospace Engineering, (I. Mech, U.K.), Acta Astronautica (Elsevier), Journal of Institution of engineers, IEEE Transactions on Neural Networks and Learning Systems, Chinese Journal of Aeronautics (Elsevier), Advances in Space Research (Elsevier), Aircraft Engineering and Aerospace Technology (Emerald)**,** AIAA J. Guidance Control and Dynamics. IEEE Aerospace Electronic Systems, Journal of Astronautical Sciences (AAS), AIAA J. of Aircraft, International J. of Dynamics and Control, IEEE Man and Cybernetics , Journal of Aerospace Science and Technology (Elsevier)

Publications (Journals)

1. Barman, S., Sinha, M., Satellite Attitude Control using Double-Gimbal Variable-Speed Control Moment Gyro: Single-Loop Control Formulation, AIAA Journal of Guidance Control and Dynamics (accepted Feb. 2023).

2. Barman, S., Sinha, M., Singularity Avoidance Controller Design for Spacecraft Attitude Control using Double-Gimbal Variable-Speed Control Moment Gyro, European Journal of Control (accepted Jan 2023).

3. Das, Gargi, Sinha, M., Unwinding-Free Fast Finite-Time Sliding Mode Satellite Attitude Tracking Control, *AIAA Journal of Guidance Control and Dynamics* https://doi.org/10.2514/1.G006949 *(accepted, 2022).*

4. *Barman, S., Sinha, M., Satellite Attitude Control using Double-Gimbal Variable-Speed Control Moment Gyro with Unbalanced Rotor, AIAA Journal of Guidance Control and Dynamics* https://doi.org/10.2514/1.G006913 *(accepted, 2022).*

5. Prabhat Himanshu, Mukherjee Bijoy K., Giri Dipak K., Sinha Manoranjan, Fault-Tolerant Sliding Mode Satellite Attitude Stabilization using Magneto-Coulombic Torquers, *Aerospace Science and Technology*, Elsevier, Vol. 121 (2022), pp. 1-12. (https://doi.org/10.1016/j.ast.2021.107316)

6. Mukherjee B. K., Goel K., Sinha M., Autonomous Super manoeuvring with a Significantly Asymmetric Fighter Aircraft, *Advances in Military Technology, Vol 15 (1), 2020.*

7. Giri, D., Sinha, M., Fast-terminal Sliding Mode Fault-tolerant Attitude Control of Magnetically Actuated Satellite, AIAA *Journal of Spacecraft and Rockets, Vol. 56, No. 5, September–October 2019.*

8. Giri, D., Sinha, M., Robust Back stepping Magnetic Attitude Control of Subject to Unsymmetrical Mass Properties, AIAA *Journal of Spacecraft and Rockets Vol. 56, No. 1, January–February 2019.*

9. Kumar K. D., Godard, Abreu N., Sinha M., Fault-tolerant attitude control of miniature satellites using reaction wheels, Acta Astronautica, Vol. 151, pp. 206-216, October 2018. (https://doi.org/10.1016/j.actaastro.2018.05.004)

10. Mukherjee B. K. and Sinha M., Nonlinear Dynamics and Control of a Laterally Mass Varying Fighter Aircraft, *Proc. IMechE Part G: Journal of Aerospace Engg.*, 2018, Vol. 232(16), pp. 3118–3134 Sage Publications. (DOI: 10.1177/0954410017723360) 2017

11. Mukherjee B. K. and Sinha M., Extreme Aircraft Maneuver under Sudden Lateral CG Movement: Modeling and Control, *Aerospace Science and Technology*, Elsevier, Vol. 68, 2017, pp. 11-25. (DOI: 10.1016/j.ast.2017.04.030)

12. Mukherjee B. K., Giri D. K. and Sinha M., Lorentz Force Based Fuzzy-PID Attitude Control for Earth-pointing Satellites", AIAA *Journal of Spacecraft and Rockets, 54(5), pp. 1-8* AIAA.

13. Giri D. K., Mukherjee B. K., Bidul T. N. and Sinha M., Three-Axis Global Magnetic Attitude Control of Earth-pointing Satellites in Circular Orbit", *Asian Journal of Control,* Wiley. (in press, 10.1002/asjc.1506, 2017)

14. Mukherjee B. K. and Sinha M., Dynamic Inversion Control for Performing Herbst Maneuver with Lateral Center of Gravity Offset, *Defence Science Journal*, DRDO, Vol. 67, No. 2, 2017, pp. 198-206.

15. Giri, D. K., and Sinha, M., Finite-time Continuous Sliding Mode Magneto-Coulombic Satellite Attitude Control, *IEEE Transactions of Aerospace Electronic Systems*, Vol. 52, No. 5, 2397-2412, Oct. 2016.

16. Giri, D. K., Sinha, M., Kumar, K. D., Fault-Tolerant Attitude Control of Magneto-Coulombic Satellites, *Acta Astronautica*, Vol. 116, pp. 254–270, 2015.

17. Giri, D. and Sinha, M., Three-axis attitude control of Earth-pointing isoinertial magneto-Coulombic Satellites, *International Journal of Dynamics and Control*, Vol. 5, No. 3, pp. 644-652, 2017, (10.1007/s40435-015-0206-x)

18. Giri, D. and Sinha, M., Magneto-Coulombic Attitude Control of Earth Pointing Satellites, *AIAA Journal of Guidance Control and Dynamics*, Vol. 37, pp. 1946-1960, 2014. (10.2514/1.G000030)

19. Lee, D., Kumar, K. D., and Sinha, M., Fault Detection and Recovery of Spacecraft Formation Flying Using Nonlinear Observer and Reconfigurable Controller, *Acta Astronautica*, Vol. 97, pp. 58-72, 2014. (10.1016/j.actaastro.2013.12.002)

20. Sinha, M., Kuttieri, R. A., Ghosh, A. K., Misra, A., High Angle of Attack Parameter Estimation of Cascaded Fins Using Neural Network, *AIAA Journal of Aircraft*, Vol. 50, No. 1, pp. 272-291, 2013. (10.2514/1.C031912)

21. Sinha, M., Kuttieri, R. A., and Chatterjee, S., Nonlinear and Linear Unstable Aircraft Parameter Estimation Using Neural Partial Differentiation, *AIAA Journal of Guidance Control and Dynamics*, Vol. 36, pp. 1162-1176, 2013. (10.2514/1.57029)

22. Jharia, D. K., Azad, A. R., Mohan, A., Sinha, M., "A Compact Modified U-shaped UWB Bandpass Filter" *Microwave and Optical Technology Letter*, Wiley, Vol. 57, No. 9, pp. 2172-2175, 2015. (10.1002/mop.29303)

23. Jharia, D. K., Azad, A. R., Mohan, A., Sinha, M., "Compact Wideband Bandpass Filter using Fish Spear-shaped Multimode Resonator (MMR)" *Microwave and Optical Technology Letter*, Wiley, Vol. 57, No. 12, pp. 2833-2837, 2015. (10.1002/mop.29437)

24. Jharia, D. K., Azad, A. R., Mohan, A., Sinha, M., "Design of Two-Stage Fish-Spear Shaped UWB Bandpass Filter with Sharp Selectivity and Good Out-of-Band Performances" *International Journal of Microwave and Wireless Technologies*, pp. 1–6, 2017. https://doi.org/10.1017/S1759078717000794

25. Das, S., Sinha, M., and Misra, A., "Dynamic Neural Units for Adaptive Magnetic Attitude Control of Spacecraft," *AIAA Journal of Guidance Control and Control*, Vol. 35, No. 4, 2012, pp. 1280-1291.

26. Das, S., Kuttieri, R. A., Sinha, M., and, Jategaonkar, R. V., "Neural Partial Differential Method for Extracting Aerodynamic Derivatives from Flight Data," AIAA Journal of Guidance Control and Dynamics, Vol. 33, No. 2, 2010, pp. 376-384.

27. Das, S. and Sinha, M., Kumar, K. D., Misra, A., Reconfigurable Magnetic Attitude Control of Earth Pointing Satellites, Journal of Aerospace Engineering, U.K., Proceedings of the Institution of Mechanical Engineers, Part G, Vol. 224, No. 12, 2010, pp. 1309-1326.

28. Singh, N. and Sinha, M., Suboptimal guidance and control design for a missile with onboard strapdown seeker, *Applied Mechanics and Materials*, Vols. 10-116, 2012, pp. 2513-2520.

29. Ghosh, S., Halder, A., and Sinha, M., Micro Air Vehicle Path Planning in Fuzzy Quadtree Framework, Applied Soft Computing, Elsevier, 11, 4859-4865, 2011.

30. Sinha, M., Gopinath, N. S., and Malik, N. K., Lunar Gravity Field Modeling Critical analysis and challenges, Journal of Advances in Space Research, Elsevier, V. 45, pp. 322-349, 2010.

31. Chauhan, S., Patil, C., Sinha, M., and Halder, A., Fuzzy State Noise Driven Kalman Filter for Sensor Fusion, Journal of Aerospace Engineering, U.K., Proceedings of the Institution of Mechanical Engineers, Part G., Vol. 223 (G8), Dec. 2009.

32. Sinha, M., Kumar K., and Kalra, P. K., Some New Neural Network Architectures with Improved Learning Schemes, Soft Computing, Springer Verlag, V. 4 (4), Dec. 2000, pp. 214-223.

33. Khare, M. and Sinha, M., Computer Aided Simulation of an Electrostatic Precipitator Efficiency, in Environment International, Pergamon Press, V. 23 (1-6), pp. 451-462, 1996.

34. Sinha, M., Kalra, P. K. and Kumar, K., "Estimation Using Compensatory Neural Network" in Sadhana, Journal of Indian Academy of Science, V. 25, part 2, April 2000, pp. 193-203.

35. Neural Partial Differentiation for Parameter Estimation of Flexible Aircraft Dynamics, Journal of Aerospace Sciences and Technologies, Vol. 68, No. 4 .

36. Giri, D. K. and Sinha, M., Lorentz Force Based Satellite Attitude Control, *Journal of Institution of Engineers*, Series C, Vol. 97, No. 3, pp. 279–290, 2015.

37. D. K. Giri and M. Sinha, Application of Dynamic Neural Network Model for Magneto-Coulombic Attitude Control of Earth-pointing Satellite *by Journal of Aerospace Sciences and Technologies*, Vol. 67, No. 2, 2015.

38. Kuttieri, R. A., Sinha, M., Neural Partial Differentiation for Aircraft Parameter Estimation under Turbulent Atmospheric Conditions, *Journal of the Institution of Engineers: Series C*, Vol 93, No. 3, 2012.

39. Kuttieri, R. A., and Sinha, M., Unstable Aircraft Parameter Estimation using Neural Partial Differentiation, *Journal of Aerospace Technologies*. Vol.64, No.3, Paper Code: V64 N3/770-2012, Aug 2012, pp. 201-216. Aug. 2012.

40. Rajesh, A. K., Das, S., Sinha, M., "Aircraft Parameter Estimation using Neural Network," Journal of Aerospace Engineering, IEI, Vol. 91, Pt-AS-01, pp. 3-9, May 2010.

41. Ghosh, S., Halder, A., & Sinha, M., "Path Planning for a UAV in Fuzzy Quad tree Framework," Aerospace Engineering Journal, Institution of Engineers, Vol. 91, Pt-AS-02, pp. 10-15, November 2010.

42. Sinha, M, Kalra, P. K., "Neural Network for Preliminary Orbit Determination," Journal of Institution of Engineers," Vol. 90, May 18, 2009.

43. Halder, A., Agrawal, V, Garhwal, R., Sinha, M., "Determination of Inertial Characteristics of a High Wing Unmanned Air Vehicle," Journal of Aerospace Engineering, IEI, Vol. 89, Nov. 17, 2008.

Conference Publications

44. Das, Gargi, and Sinha, M., Unwinding and Singularity Free Satellite Attitude Control Using Double Gimbal Variable Speed Control Moment Gyro and Sliding Contrrol, 72nd *International Astronautical Congress*, Dubai, UAE, 2021.

45. Barman, S., Sinha, M., High Precision Satellite Attitude Control Using Double Gimbal Variable Speed Control Moment Gyro with Unbalanced Rotor, 72nd *International Astronautical Congress*, Dubai, UAE, 2021.

46. Prabhat, H., Mukherjee, B. K., and Sinha M., Magneto-Coulombic Fault Tolerant Sliding Mode Attitude Control of Earth Pointing Satellites, *68th International Astronautical Congress,* Adelaide, Australia, September 2017.

47. Mukherjee B. K. and Sinha M., Large Angle Maneuvering with an Asymmetric Aircraft: A Single Loop Control Formulation, *AIAA Guidance Navigation and Control Conference*, Florida, USA, January 2018.

48. Mukherjee, B. K. and Sinha M., Modeling and Bifurcation Analysis of Combat Aircraft Dynamics under Lateral C.M. Shift, *AIAA Atmospheric Flight Mechanics Conference*, San Diego, USA, January 2016.

49. Mukherjee B. K., Thomas P. R. and Sinha M. Automatic Recovery of a Combat Aircraft from a Completed Cobra and Herbst Maneuver: A Sliding Mode Control Based Scheme", *Indian Control Conference*, IIT Hyderabad, January 2016.

50. Sinha M., Giri D. K., Bidul T. N. and Mukherjee B. K., Adaptive Fault-Tolerant Coulombic Satellite Attitude Control, *66th International Astronautical Congress*, Jerusalem, Israel, October 2015.

51. Dharmendra Kumar Jhariya, Amit ranjan Azad, Akhilesh Mohan, Manoranjan Sinha, "Compact UWB Bandpass Filter with Notched Band Using Multiple-Mode Resonator," *IEEE Applied Electromagnetics conference (AEMC)* at IIT Guwahati, pp. 1-2, December 2015. 10.1109/AEMC.2015.7509191

52. Dharmendra Kumar Jhariya, Akhilesh Mohan, Manoranjan Sinha, "Compact Differential Wideband Bandpass Filter Resonator," *IEEE Asia Pacific Microwave conference (APMC)* at New Delhi India, 5-9 Dec. 2016. 10.1109/APMC.2016.7931357

53. Dharmendra Kumar Jhariya, Akhilesh Mohan, Manoranjan Sinha, "A Differential Wideband Bandpass Using Slot Resonator," 3rd ***I****EEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics (UPCON'2016)* at IIT (BHU) Varanasi India, 9-11 Dec. 2016. 10.1109/UPCON.2016.7894684

54. Halder, A., Giri, D. K., and Sinha, M., "Adaptive Integrator Backstepping Control for Magnetically Actuated Satellite", IFAC Proceedings, Vol. 47, No. 1, 2014, pp. 255-262.

55. Giri, D. K., and Sinha, M., "Finite-time Continuous Sliding Mode Magneto-Coulombic Attitude Control", 64th International Astronautical Congress, Beijing, China, 23 September -27 September, 2013.

56. Giri, D. K., and Sinha, M., "Magneto Coulombic Attitude Control of Earth Pointing Satellites", AIAA Guidance, Navigation, and Control Conference, Boston, Massachusetts, USA, 19-22 Aug 2013.

57. Giri, D. K., Mukherjee, B. K., Bidul, T. N., and Sinha, M., "Adaptive Fault-tolerant Coulombic Satellite Attitude Control", 66th International Astronautical Congress, Jerusalem, Israel, 12 October -16 October, 2015.

58. Giri, D. K., Bidul, T. N., and Sinha, M., "Robust Backstepping Control of Magnetically Actuated Satellites with Unsymmnetrical Mass properties", 65th

International Astronautical Congress, Toronto, Canada, 29 September -3 October, 2014.

59. Singh, N. and Sinha, M., "Suboptimal Guidance and Control Design for a Missile of with On-board Strapdown Seeker," in CMAE 2011, March 19-20, 2011, New Delhi.

60. Das, S., Sinha, M., and Misra, A., "Dynamic neural units for an adaptive magnetic attitude control of a satellite," in AIAA Astrodynamics conference, 2-5 August, 2010, Toronto, Canada.

61. Das, S., Narayanan, T. Bidul, Sinha, M., Misra, A., "Formation flying in an eccentric low earth orbit," in AIAA Astrodynamics conference, 2-5 August, 2010, Toronto, Canada.

62. Chauhan, S., Patil, C., Halder, A. Sinha, M., "Fuzzy State Noise Driven Kalman Filter for Sensor Fusion," IEEE International Conference, Kharagpur, 2009.

63. Sinha, M., Gopinath, N. S., & Malik N. K., "Accurate Transformations of Coordinates and Orbit Propagation of Lunar Satellite in the wake of IAU2000A Resolutions," in Astrodynamics Symposium, 58th International Astronautical Congress, organized by international Astronautical Federation, France, 2007, Hyderabad, India, Sept. 24-28, 2007.

64. Sinha, M., Gopinath, N. S., & Malik N. K., "A Critical Analysis of Various Methods for Lunar Gravity Field Modeling," in Space Exploration Symposium, 58th international Astronautical Congress organized by International Astronautical Federation, France, 2007, Hyderabad, India, Sept. 24-28, 2007.

65. Garhwal, R., Halder, A., & Sinha M., "An Adaptive Fuzzy State Noise Driven Extended Kalman Filter for Real Time Orbit Determination," in 37th Student Conference, 58th international Astronautical Congress organized by International Astronautical Federation, France, 2007, Hyderabad, India, Sept. 24-28, 2007.

66. Ghosh, S., Halder, A., & Sinha, M., "Path Planning for a Fixed Wing Micro Air Vehicle in Fuzzy Quad tree Framework," in 3rd US-European Competition and Workshop on Micro Air Vehicle Systems& European Micro Air Vehicle Conference and Flight Competition, Toulouse, France, Sept. 17-21, 2007.

67. Halder, A. Ghosh, S., & Sinha, M., "Fuzzy Quad tree based Path Planner and Trajectory Smoother for a Low Cost Unmanned Aerial Vehicle," in 3rd Indian international Conference on Artificial Intelligence (IICAI-07), Pune, India, Dec. 17-19, 2007.

68. Garhwal, R., Halder, A., & Sinha, M., "Sensitivity Analysis using Neural Network for Estimating Aircraft Stability and Control Derivatives," in

International Conference on Intelligent and Advanced Systems (ICIAS) (with IEEE), Kuala Lumpur, Malaysia, Nov. 25-28, 2007.

69. Agrawal, V., Halder, A., Garhwal, R., Gupta, A., Ghosh, S., Saxena, S., and Sinha, M., "Inertial Characterization of Unmanned Aerial Vehicle AX-1," in Proceedings of 4th ICTACEM, IIT Kharagpur, 27-29 December, 2007.

70. Sinha, M., Gupta M. M. & Nikiforuk, P. N., "Hybrid Neural Models for Time-Series Forecasting", in International Federation of Automatic Control World Congress, Barcelona, Spain, July 21-26, 2002.

71. Sinha, M., Gupta M. M. & Nikiforuk, P. N., "Compensatory Wavelet Neuron Model," in the Proceedings of International Fuzzy Systems Association (IFSA)/North American Fuzzy Information Processing Society (NAFIPS) World Congress, Vancouver, Canada, v.3, July 25-28, 2001, pp. 1372 – 1377.

72. Rajesh, A. K., Sinha, M., and Jategaonkar, R. V. "Neural Network Based Partial Differential Method for Extracting Aerodynamic Derivatives from Flight Data, "Symposium on Applied Aerodynamics and Design of Aerospace Vehicle (SAROD 2009), December 10-12, 2009, Bangalore, India.

73. Rajesh, A. K., Sinha, M., "Parameter Estimation of Unstable Aircraft using Neural Networks," Symposium on Applied Aerodynamics and Design of Aerospace Vehicle (SAROD 2011), November 16-18, 2011, Bangalore.

74. Bidul T. Narayanan and Sinha, M., "Formation Flying in Small Eccentric Low Earth of Orbit," in IEI conference, 13-14 Nov., Jaipur, 2010.

75. Singh, N. and Sinha, M., "Moving and Stationary Target Interception with Strapdown Seeker," in IEI conference, 13-14 Nov., Jaipur, 2010.

76. Mandal, T. K., Shukla, H., Vimal, G. S., Sinha, M., "Atmega128 based autonomous UAV attitude stabilization," in IEI conference, 13-14 Nov., Jaipur, 2010.

77. Rajesh, A. K., Sinha, M., "Investigation of Flight Vehicle System Identification using Neural Partial Differential Method", 25th National Convention of Aerospace Engineers, November 4-5, 2011, BIT Mesra, Ranchi.

78. Sinha, M., Halder, A., Garhwal, R., Gopinath, N. S., and Malik, N. K., "Lunar Satellite Observation Vector Construction using Non-rotating Origin and IAU 2000A precession nutation model", in STC-IITKGP-ISRO conference, IIT Kharagpur, 2008