Brief Biography of Prof. Siddhartha Sen

Office:	Department of Electrical Engineering, IIT Kharagpur, 721302
Residence:	Flat no. A-70 IIT Campus, Kharagpur
Present Position :	Professor, Department of Electrical Engineering, Indian Institute of Technology Kharagpur.
Phone:	03222-283084(O),03222-282262(Head), 03222-283085(R), 03222-27728(R)

Details of Employment:	
1.	Damodar Valley Corporation (1980-81) (as Assistant Engineer- Trainee)
2.	Regional Institute of Technology, Jamshedpur (1982-84) (as Lecturer)
3.	Indian Institute of Technology Kharagpur (1984-) (joined as Lecturer, presently Professor)

Academic Qualification

Degree	**Institute**	**Year**	**Subject**
B. E.E.	Jadavpur University	1977	Electrical Engineering
M. Tech.	I.I.T. Kharagpur	1980	-do-
Ph. D.	I.I.T. Kharagpur	1992	-do-

Research Interests:

1. Instrumentation
2. Control Systems
3. Fractional order Circuits and Systems
4. MEMS

Awards:

- Best project award for RDCIS. SAIL (1999)
- A.H. Zemanian Best Paper Award (2013)

List of Ph.D students guided (graduated):

1.	Ratna Ghosh, *Robust Stability of LTI Systems: A Matrix Approach*, 1997.
2.	Shakuntala Laskar, *Modelling and Analysis of Electro-optic Sensor using Finite Element Technique*, 2001 (jointly with Prof. P.K. Dutta).
3.	Anirban Mukherjee, *Object-based Representation and Coding-decoding of Two-dimensional Shape, Motion and Texture*, 2003, (jointly with Prof. P.K. Dutta).
4.	Karabi Biswas, *Studies on Design, Development and Performance Analysis of Capacitive Type Sensors*, 2006 (jointly with Prof. P.K. Dutta).

5.	Saurav Patra, *Linear Matrix Inequality Approach to H-infinity Loop Shaping Control Problem*, 2008, (jointly with Prof. G.D. Ray).
6.	W.C. Arun Kishore, *Control Allocation and Disturbance Rejection for Over-actuated Systems*, 2009.
7.	Raj Kumar Biswas, *Fractional Optimal Control Problem*, 2012.
8.	Sougata Kumar Kar, *A Linear Transconductance Amplifier and its Application in Capacitance Systems*, 2013.
9.	Madhab Chandra Tripathy, *Design and Performance Analysis of Fractional Order Filters*, 2015, (jointly with Prof. K. Biswas).
10.	Asim Kumar Naskar, *Control Allocation Methods and Applications to Overactuated Systems*, 2016.
11.	Banibrata Mukherjee, *Modelling, Performance Analysis and Testing of Electrostatically Actuated Micro and Nano Structures*, 2016.
12.	Mruthyunjaya Swamy K.B.M, *Performance Improvement of MEMS based Capacitance Comb Accelerometers,* 2016 (jointly with Prof. S. Chakraborty).
13	Avishek Adhikary, *Four-Quadrant Fractors and their Applications in Fractional Order Circuits",* 2018, (jointly with Prof. K. Biswas)

List of M.S. Students guided (graduated):

1.	Anand Dhabade, Studies on lossy compression techniques for medical image compression, 2001 (jointly with Prof. N.C. Roy).
2.	Rudra Kanta Das, *Design of Robust Fault Tolerant Controllers for Attitude Control of Sattelite Launch Vehicles*, 2005 (jointly with Dr. S. Dasgupta).
3.	Abhishek Chaki, 2006, MEMS capacitive accelerometer
4.	Parama Ghoshal, *Development of Wire Mesh Tomography for Gas-Liquid Flow*, 2008, (Jointly with Prof. G. Das)
5.	Anwesha Sengupta, *Control Allocation and Fault Reconfiguration for Sattelite Launch Vehicles*, 2011 (jointly with Prof. G.Ray)
6.	Procheta Chatterjee, *Design and Testing of Signal Conditioning Units for MEMS Capacitive Accelerometers*, 2016, (jointly with Prof. K. Biswas).

Publications

Books:

- M.K. Ghosh, S.Sen and S.Mukhopadhyay (ed.): Measurement and Instrumentation Trends and Applications, Ane Books, New Delhi, 2008.
- S. Mukhopadhyay, S. Sen and A.K. Deb: Industrial Instrumentation, Control and Automation, Jaico, Delhi 2013.

Chapters in Edited Volumes:

1. A. Patra, S. Mukhopadhyay and S. Sen, Adaptive and neural approaches to fault tolerant control, Contributed to *The Encyclopedia of Life-Support Systems,* UNESCO-EOLSS Joint Committee, 2001.

2. P.K. Das, G.Das, S.Sen and K.Biswas, Impedance Technique for Measurement of Two Phase Flow Parameters, in *Computerised Tomography for Scientists and Engineers,* (Ed. P. Munshi), Anamaya Publishers, New Delhi, 2007.

3. S. Sen, Instrument Performance Evaluation, in *Measurement and Instrumentation Trends and Applications,* (Ed. M.K. Ghosh, S.Sen and S.Mukhopadhyay), pp. 35-56, Ane Books, New Delhi, 2008.

4. S.Sen, Electrical Sensors, in in *Measurement and Instrumentation Trends and Applications,* (Ed. M.K. Ghosh, S.Sen and S.Mukhopadhyay), pp.59-84, Ane Books, New Delhi, 2008.

5. K.Biswas, S. Sen and P.K. Dutta, Design of MEMS Capacitive Accelerometers, in *Measurement and Instrumentation Trends and Applications,* (Ed. M.K. Ghosh, S.Sen and S.Mukhopadhyay), pp. 267-282, Ane Books, New Delhi, 2008.

6. Dushyant Juneja, Sougata Kar, Procheta Chatterjee, and Siddhartha Sen, "SOI MEMS Based Over-Sampling Accelerometer Design with ΔΣ Output", in Progress in VLSI Design and Test, pp. 121-128, LNCS 7373 (Springer), 2012.

Journal Publications:

2018

Kumar M., Mukherjee B, Swamy K.B.M and Sen S., A Novel Design for Enhancing the Sensitivity of a Capacitive MEMS Device, ***IEEE Journal of Microelectromechanical Systems***, 2018 (to appear).

Adhikary A., Chowdhary S. and Sen S., Optimal Design for Realizing a Grounded Fractional Order Inductor using GIC, ***IEEE Transactions on Circuits and Systems I***. vol. 65 (8), pp.2411-2421, 2018.

Kar S.K., Chatterjee P., Mukherjee B., Swamy K.B.M. and Sen S., A Differential Output Interfacing ASIC for Integrated Capacitive Sensors, ***IEEE Transactions on Instrumentation and Measurement***, vol.67, pp.196-203, 2018.

Mukherjee B. and Sen S., Generalized closed form solutions for feasible dimension limit and pull-in characteristics of nanocantilever under the Influences of van Der Waals and Casimir forces, ***Materials Research Express*** (IOP), vol.5, no.4, page 045028, 2018.

Mukherjee B., Swamy K.B.M.and Sen S., Study on dynamic actuation in double microcantilever-based electrostatic microactuators with in-house experimental set-up, ***Journal of Micro/Nanolithography, MEMS, and MOEMS (JM3)***, vol.17 (1), 015004, 2018.

Dey A., Patra S. and Sen S., Stability analysis and controller design for Lur'e system with hysteresis nonlinearities: A negative-imaginary theory based approach, ***International Journal of Control***, DOI: 10.1080/00207179.2017.1418909, 2018 (accepted).

Sen T., C.S. Anoop and Sen S., Simple linearizing front-end-circuit for giant magneto-resistance sensors, ***Electronic Letters***, vol.54 (2), pp.81-83, 2018.

Brief Biography of Prof. Siddhartha Sen

2017

Naskar A.K., Patra S. and Sen S., New Control Allocation Algorithms in Fixed Point Framework for Overactuated Systems with Actuator Saturation, ***International Journal of Control***, vol. 90, pp.348-356, 2017.

Adhikary A., Sen S. and Biswas K., Design and Hardware Realization of A Tunable Fractional Order Series Resonator with High Quality Factor, ***Circuits, Systems and Signal Processing***, vol. 36, pp. 3457-3476, 2017.

Sen T., C.S. Anoop and Sen S., Design and Performance Evaluation of Two Novel Linearization Circuits for Giant Magneto-Resistance Based Sensors, ***IET Circuits Devices and Systems***, vol.11, pp. 496-503, 2017.

2016

Adhikary A., Sen S. and Biswas K., Practical realization of tunable fractional order parallel resonator and fractional order filters, ***IEEE Transactions on Circuits and Systems-I***, vo.63, pp.1142-1151, 2016.

Dey A., Patra S. and Sen S., Absolute Stability Analysis for Negative-Imaginary Systems, ***Automatica***, 67:107-113, 2016.

Naskar A.K., Patra S. and Sen S., A control theoretic approach for solving underdetermined problems and its applications to control allocation. ***ASME Journal of Dynamic Systems, Measurement and Control***, vol.138, 044501-6, 2016.

Das P. and Sen S., Introducing fractional order dynamics to sigma-delta modulators, ***Circuits, Systems and Signal Processing***, vol. 35, pp.2109-2124, 2016.

Adhikary A., Sen P., Sen S. and Biswas K., Design and Performance Study of Dynamic Fractors in Any of the Four Quadrants, ***Circuits, Systems and Signal Processing***, vol. 35, pp.1109-1932, 2016.

Mukherjee B., Swamy K.B.M.and Sen S., Dynamic characteristics of voltage induced reciprocated bending in double cantilever configuration of asymmetric comb drive MEMS, ***Microsystem Technologies***, vol. 22, no.5, pp. 1089-1103, 2016.

2015

Kar S.K., Swamy K. B. M., Mukherjee B. and Sen S., Systematic Development of Integrated Capacitance Measurement System with Sensitivity Tuning, ***IEEE Transactions on Instrumentation and Measurement***, vol. 64, pp. 2738-2746, 2015.

Tripathy M.C., Mondal D., Biswas K. and Sen S., Experimental Studies on Realization of Fractional Inductors and Fractional-order Bandpass Filters, ***International Journal of Circuit Theory and Applications***, vol. 43, pp.1183-1196, 2015.

Naskar A.K., Patra S. and Sen S., Reconfigurable Direct Allocation for Multiple Actuator Failures, ***IEEE Transactions on Control Systems Technology***, vol. 23, pp. 397-405, 2015.

Tripathy M.C., Mondal D., Biswas K. and Sen S., Design and performance study of phase-locked loop (PLL) using fractional-order loop filter, ***International Journal of Circuit Theory and Applications***, vol.43, pp. 776-792, 2015.

2014

Swamy K.B.M, Mukherjee B., Ali Z., Chakraborty S., and Sen S.' Performance Evaluation of Perforated Micro-Cantilevers for MEMS Applications, ***Journal of Micro/Nanolithography, MEMS, and MOEMS (JM3)***, vol.13 (2), 023001, 2014.

Mukherjee B., Swamy K.B.M.and Sen S., A New Analysis of Reciprocated Beam Bending in Electrostatic Comb Drives using a Semi-analytical Approach, ***Communications in Nonlinear Science and Numerical Simulation***, vol. 19, pp. 2115-2130, 2014.

Biswas R.K. and Sen S., Free final time fractional optimal control problems, ***Journal of Franklin Institute***, vol. 351, pp. 941-951, 2014.

2013

Kar S.K., Swamy K. B. M., Mukherjee B. and Sen S., Testing of MEMS capacitive sensor through electro-static actuation, ***Microsystem Technologies***, vol. 19, no. 1, pp.79-87, Jan. 2013.

Kar S.K and Sen S., Linearity Improvement of Source Degenerated Transconductance Amplifiers, ***Analog Integrated Circuits and Signal Processing***, vol.74, pp.399-407, 2013.

Arun Kishore W.C., Dasgupta S., Ray G. and Sen S., Control Allocation for an Over-Actuated Satellite Launch Vehicle, ***Aerospace Science and Technology***, vol.28, pp.56-71,2013.

Saha D., Mondal D. and Sen S., Effect of initialization on a class of fractional order systems: experimental verification and dependence on nature of past history and system parameters, ***Circuits, Systems and Signal Processing***, vol.32, no. 4, pp.1501-1522, 2013.

Tripathy M.C., Biswas K. and Sen S, .Design and performance study of fractional order KHN biquad filters with two different exponents, ***Circuits, Systems and Signal Processing***, vol.32, no. 4, pp.1523-1536, 2013.

2012

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Patra S., Sen S. and Ray G., Load frequency control of interconnected power systems via low order H-infinity loop shaping controller, ***International Journal of Power and Energy Systems***, vol.32, no.4, pp.167-173, 2012.

Kar S.K and Sen S., A highly linear CMOS transconductance amplifier in 180nm process technology, ***Analog Integrated Circuits and Signal Processing***, vol. 72, pp. 163-171, 2012.

2011

Kar S.K. and Sen S., Tunable Square-Wave Generator for Integrated Sensor Applications, ***IEEE Transactions on Instrumentation and Measurement,*** vol. 60, no. 10, pp. 3369-75, 2011.

Patra S., Sen S. and Ray G., A Linear Matrix Inequality Approach to Parametric H-infinity Loop Shaping Control, ***Journal of the Franklin Institute***, vol. 348, no.8, pp.1832-1846, 2011.

Biswas R.K. and Sen S., Fractional Optimal Control Problems with Specified Final Time**,** ***ASME Journal of Computational and Nonlinear Dynamics***, vol.6, April, 021009 (1-6), 2011.

Biswas R.K. and Sen S., Fractional Optimal Control Problems: A Pseudo-State Space Approach**,** ***Journal of Vibration and Control***, vol.17, no. 7, pp. 1034-1041, 2011.

Patra S., Sen S. and Ray G., Design of H_infinity Loop Shaping Controller for LTI System with Input Saturation: Polytopic Gain Scheduled Approach, ***ASME Journal of Dynamic Systems Measurement and Control***, vol.133, no.1, Jan.2011.

2010

Patra S., Sen S. and Ray G., Pre-compensator Selection for H-infinity Loop Shaping Control ***International Journal of Control, Automation and Systems***, vol. 8, pp.45-51, 2010.

Patra S., Sen S. and Ray G., Robust control of Uncertain LTI Plant with Input Saturation Constraint: H-infinity Loop Shaping Approach, ***International Journal of Systems Science***, vol.41, pp. 1337-1351, 2010.

Mistry K.K., Swamy K.B.M. and Sen S., Design of An SOI-MEMS High Resolution Capacitive Type Single Axis Accelerometer, ***Microsystem Technologies***, vol. 16, no. 12, pp. 2057-2066, 2010.

Chakraborty S., Swamy K.B.M., Sen S. and Bhattacharyya T.K., An experimental analysis of electrostatically vibrated array of polysilicon cantilevers, ***Microsystem Technologies***, vol. 16, no. 12, pp. 2131-2145, 2010.

2008

Arun Kishore W.C., Sen S., Ray G. and Ghoshal T.K.: Dynamic control allocation for tracking time-varying control of demand, ***Journal of Guidance, Control and Dynamics***, vol.31, no.4, pp. 1150-1157, 2008.

Patra S., Sen S. and Ray G.: Design of H-infinity loop shaping controller in four-block framework using LMI approach, ***Automatica***, vol. 44, no. 8, pp.2214-2220, 2008.

Biswas K., Thomas L., Chowdhury S., Adhikari B., Sen S., Impedance Behaviour of a Microporous PMMA-Film Coated Constant Phase Element based Chemical Sensor**,** ***International Journal of Smart Sensing and Intelligent Systems***, vol.1, no.4, pp.922-939, 2008.

2007

Das R.K., Sen S. and Dasgupta S.: Robust and Fault Tolerant Controller for Attitude Control of a Satellite Launch Vehicle, ***IET Control Theory and Applications***, vol.1, pp.304-312, 2007.

Patra S., Sen S. and Ray G.: Design of Robust Load Frequency Controller: H_∞ Loop Shaping Approach, ***Electric Power Components and Systems***, vol.35, pp.769-783, 2007.

Mukherjee A., Ray T., Chaudhuri S., Dutta P.K., Sen S. and Patra A.: Image based classification of defects in frontal surface in fluted ingot, ***Measurement***, vol.40, pp. 687-698, 2007.

Biswas K., Sen S. and Dutta P. K: MEMS Capacitive Accelerometers, ***Sensor Letters***, vol.5, pp1-14, 2007.

2006

Biswas K., Sen S. and Dutta P. K.: Realization of a Constant Phase Element and its performance study in a differentiator circuit, ***IEEE Transactions on Circuits and Systems-II*** *Express Briefs*, vol.53, no.9, pp.802-806, 2006.

Biswas K., Sen S. and Dutta P. K.:A Constant Phase Sensor for monitoring microbial growth, ***Sensors and Actuators-B***, vol.119. pp.186-191, 2006.

Mukherjee A., Chaudhuri S., Dutta P.K., Sen S. and Patra A.: An object based coding scheme for frontal surface of defective fluted ingots, ***ISA Transactions*** , Vol. 45, no.1, pp.1-8, 2006.

2005

Biswas K., Sen S. and Dutta P. K.: Modeling of a Capacitive Probe in a Polarizable Medium, ***Sensors and Actuators-A***, vol.120. pp.115-122, 2005.

Before 2005

Mukherjee A., Choudhuri S., Dutta P.K., Sen S. and Patra A.: A novel shape-based coding-decoding technique for an industrial visual inspection system, ***ISA Transactions***, (American Institute of Physics), Vol. 43, no.1, p.1, 2004.

Sen S. and Kumar S.: A Fault Tolerant Optimal Servo System using Adaptive Critic Algorithm, ***Praitantra***, (Journal of Systems Society of India), Vol.8, pp.40-47, 2003.

Sen S., Das P.K., Dutta P.K., Maiti B., Chaudhuri S., Mondal C. and Ray S.K.: PC-based gas-solid two-phase mass flowmeter for pneumatically conveying systems, ***Flow Measurements and Instrumentation***, vol. 11 , pp.205-212, 2000.

Ghosh R., Sen S. and Datta K.B.: An improved method for determining the stability of interval matrices, ***International Journal of System Science***, vol.31, pp.171-176, 2000.

Ghosh R., Sen S. and Datta K.B.: Method for evaluating stability bounds for discrete-time singularly perturbed systems, ***Proceedings IEE (part-D), Control Theory and Applications***, vol.146, pp.227-233, 1999.

Ghosh R., Sen S. and Datta K.B.: Stability bounds for high-gain feedback systems, ***Journal of Institution of Engineers (India)***, vol.78, pp.196-198,1998.

Ghosh R., Sen S. and Datta K.B.: Block bialternate sum with application to computation of stability bounds, ***Kybernetika***, vol.33,pp.445-461, 1997.

Gupta D. , Sen S. and Das P.K.: Finite difference resistance modelling for liquid level measurement in stratified gas-liquid system, ***Measurement Science and Technology***, vol.5, pp.574-579, 1994.

Sen S. and Datta K.B.: Time-optimal control algorithm for two-time-scale discrete systems- a multi-rate approach, ***Control Theory and Advanced Technology***, vol.9, pp.733-743, 1993.

Sen S. and Datta K.B.: Stability bounds of singularly perturbed systems, ***Transactions IEEE on Automatic Control***, vol.38, pp.302-304, 1993.

Sen S. and Datta K.B.: Singular perturbation analysis of discrete cheap control problems, ***International Journal of System Science***, vol.23, pp.57-70, 1992.

Sen S. and Datta K.B.: Eigenstructure assignment in high-gain feedback systems, ***Proceedings IEE (part-D), Control Theory and Applications***, vol.138, pp.165-171, 1991.

Sen S. and Naidu D.S.: Time-optimal control algorithm for two-time-scale discrete systems, ***International Journal of Control***, vol.47, pp.1595-1602, 1988.

Ray S. and Sen S.: Some new facts about three phase ferroresonance, ***Journal of Institution of Engineers (India)***, vol.67, pp.261-267, 1987.

Naidu D.S. and Sen S.: Singular perturbation methods for transient analysis of a transformer, ***Electric Power Systems Research***, vol.1, pp.307-313, 1982.

Brief Biography of Prof. Siddhartha Sen

Ongoing sponsored projects:

1. Design and Development of Closed-Loop MEMS Capacitive Accelerometer, sponsored by STC, ISRO, (2016-2018) (Principal Investigator)
2. Development of a Cost Effective Left Ventricular Assist Device (LVAD) with Centrifugal Mechanical Circulator, Drive System and Associated Control (2017-20) (Co-Principal Investigator).

List of major completed sponsored projects as Principal Investigator:

1. Design and development of two-phase mass flow meter (gas-solid) for pneumatic conveying system, sponsored by *RDCIS SAIL and TDM-CNIA,* Project cost Rs. 22 lakhs, *(completed in 1997).*
2. Design and Development of a signal processing System-on-Chip (SOC), *sponsored by MHRD,* Project cost Rs. 6.00 lakhs *(completed in 2007).*
3. Design of a MEMS based Capacitance Accelerometer, *sponsored by ISRO*, Project Cost 5.80 lakhs *(completed in 2007).*
4. Development of MEMS based Capacitive Accelerometer, *sponsored by DIT (MCIT),* Project Cost Rs. 122.00 lakhs, *(completed in 2010).*
5. Design and fabrication of MEMS SOI capacitive accelerometer, sponsored by DST, total project cost Rs. 28.6 lakhs, *(completed in 2012).*
6. Testing and Characterization of In-house Developed MEMS Capacitive Accelerometer, sponsored by ISRO-STC, total project cost Rs. 6.7 lakhs, *(completed in 2014).*

Patents:

1. Conductivity probe for multi-phase systems: Indian patent application no. 408/cal/92 , dt. 8.6.92 (joint) Conductivity probe for multi-phase systems: Indian patent application no. 408/cal/92 , dt. 8.6.92 (joint).
2. An Instrumentation system for measurement of velocity of materials in two-phase flow: Indian patent application no. 481/del/97 , dt. 25.2.97 (joint).
3. An improved instrumentation system for measurement of velocity of solid particles in a two-phase gas-liquid flow through a pneumatic conveyor: Indian patent application no. 3004/del/97 , dt. 20.10.97 (joint).
4. A non-invasive instrumentation system for measurement of mass flow rate of bulk solid in a pneumatic conveying system: Indian patent application no. 1883/del/98, dt. 3.7.98 (joint).

Other Major Institutional/Professional Activities:

- Professor-in-Charge, Counselling Centre, 2018- .
- Head, Electrical Engineering, 2013-17.
- Chairman *GATE*, 2011-12.
- Convenor, *27th National Systems Conference (NSC-2003),* System Society of India, held at IIT Kharagpur during Dec. 17-19, 2003.
- Coordinator of the short term course *Frontiers of Measurements and Instrumentation,* at the Electrical Engineering Department, IIT Kharagpur, during May 2002.

Brief Biography of Prof. Siddhartha Sen

- Coordinator of the short term course *MEMS and Microsystems*, at KCSTC, IIT Kharagpur, during May 2007.
- Rector's nominee for social and cultural activities in *Technology Students' Gymkhana* during the period 2000-2002.
- Chairman, *Spring Festival* for the year 2001.
- Chairman, *Kshitiz* for the year 2005.
- Member Syllabus Review Committee, GATE.
- Fellow, Institution of Engineers (India).
- Member, IEEE.
- Associate Editor, *International Journal on Smart Sensing and Intelligent Systems*.
- Member, Editorial Board, *International Journal of Applied and Computational Mathematics* (Springer).

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