Saurabh Singh

Contact Information

Civil, Environmental and Geomatic Engineering
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Research Interests

Experimental soil mechanics, constitutive modelling, micro-mechanical studies on granular materials, image analysis, and numerical methods in geomechanics.

Education

Indian Institute of Science, Bangalore, India

Ph.D., (Geotechnical Engineering), July 2020

- Dissertation: "Weakly cemented granular materials: study at multiple length scales"

Indian Institute of Science, Bangalore, India

M.E., (Civil Engineering - Geotechnical Engineering), June 2014

- Dissertation: "Evolution of deformation fields in 1-g model footings"

Harcourt Butler Technological Institute, Kanpur, India

B.E., (Civil Engineering), May 2012

- Dissertation: "Analysis and design of high rise buildings"

Honors and Awards

- International Society for Soil Mechanics and Geotechnical Engineering (**ISSMGE**) Foundation Award, 2016
- **NS Lakshmana Rao Gold Medal** for best ME student in Civil Engineering, 2014

Academic Experience

University College London, London, United Kingdom
Postdoc Researcher – Civil, Environmental and Geomatic Engineering

- Extraction of real contact area between sand particles
- Characterization of contact behavior of sand **May 2022 -**

Indian Institute of Science, Bangalore, India
Postdoc Researcher, Computer Science and Automation

- Effect of constraints on propagation of forces in granular materials
- Image segmentation using Morse-Smale complexes **May 2021 - March 2022**

Indian Institute of Science, Bangalore, India
Postdoc Researcher, Department of Civil Engineering

- Analysis of natural soil structures **August 2020 - March 2021**

Georgia Institute of Technology, Atlanta, U.S.A
Visiting Scholar Dr. Christopher J. Saldana's lab

- Micro-mechanical studies on cemented granular materials using X-ray computed tomography and image processing for quantification of fabric **June 2017 - September 2017**

Indian Institute of Science, India
Teaching Assistant

- Graduate level course - Basic Geomechanics **August 2015, 2016, 2018**
- Finite element analysis (centre for continuing education - CCE) **Jan 2017**
- Geomechanics (CCE) **May 2018**

Instructor

- Getting started with Matlab for new graduate students **August 2016**

Experimental Skills

- Soil characterization test – sieve analysis, hydrometer test, consistency limits
- Elemental laboratory test – direct shear, triaxial compression, hollow cylinder torsional shear test
- Physical model test – model footing, cutting of granular media
- X-ray computed tomography – volume scanning

Programming and computational background

- Numerical integration of constitutive models
- Image based deformation analysis (particle image velocimetry, particle tracking velocimetry)
- Three dimensional image visualization and processing
- Inverse analysis for force extraction from photo-elastic granular ensemble
- Languages – MATLAB, PYTHON, C, C++, FORTRAN, LaTeX
- Softwares – ABAQUS, PLAXIS, ParaView, deal.II, AutoCAD
- Repository of codes – `https://github.com/ssingh09299`

Journal Publications

Singh S., Kandasami R.K., and Murthy T.G., (2017) "Prediction of mechanical response of geomaterials using an advanced elasto-plastic constitutive model", *Procedia Engineering*, Elsevier, Vol. 173, pp. 793–799.

Singh S., Miers J.C., Saldana C.J., and Murthy T.G., (2020) "Quantification of fabric in cemented granular materials", *Computers and Geotechnics*, Vol. 125, p. 103644

Zachariah N., **Singh S.**, Murthy T.G., and Borges R.M., (2020) "Bi-layered architecture facilitates high strength and ventilation in nest mounds of fungus-farming termites", *Sci Rep*, Nature, Vol. 10, article number 13157.

Kandasami R. K., **Singh S.**, and Murthy T. G., (2021) "Experimental Investigations of the Stress Path Dependence of Weakly Cemented Sand", *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 147, Issue 4 (April 2021).

Beleyur T., Uma D., **Singh S.**, Somanathan H., and Murthy T.G., (2021) "The architecture, dynamics, and silk investment in social spider, Stegodyphus sarasinorum", Animal Behaviour, Vol. 179, Pages 139-146.

Pandey, K., Bin Masood, T., **Singh, S.**, Hotz, I., Natarajan, V. and Murthy, T.G., (2022) "Morse theory-based segmentation and fabric quantification of granular materials", Granular Matter, 24(1), pp.1-20.

Singh, S. and Murthy, T.G., (2022) "Evolution of structure of cohesive granular ensembles in compression", International Journal of Solids and Structures, p.111359.

Singh S., Kandasami R.K., Murthy T.G., and Coop M.R., "On the stress transformation and stress-dilatancy of weakly cemented sands", Soils and Foundations (Under review).

Singh S. and Murthy T.G., "Fabric entanglement gives rise to an additional length scales in contact bound cohesive frictional graular media", (In preparation).

Murthy T.G., **Singh S.**, Natarajan V., and Daniels K.E., "Effect of deformation constraints on force network in granular ensemble", (In preparation).

Singh S. and Murthy T.G., "Extraction of elastic-plastic components with generalized stress path data-set for cemented sands", (In preparation).

Singh S., Kandasami R.K., Murthy T.G., "Effect of anisotropy and stress path on elastic-plastic behaviour of angular sand", (In preparation).

Conference Proceedings

Yadav S., **Singh S.**, Kandasami R. K., Murthy T. G., and Saldana C., (2014) "Experimental studies on the cutting of granular materials", *Geomechanics from Micro to Macro*, Taylor & Francis Group, London, Vol. 2, pp. 1209–1212, ISBN 978-1-138-02707-7.

Singh S., Kandasami R.K., Mahendran R.K., and Murthy T.G., (2017) "System size effects on the mechanical response of cohesive-frictional granular ensembles", *EPJ Web of Conferences*, EDP Sciences, Vol. 140, pp. 08007.

Singh S., Kandasami R.K., and Murthy T.G., (2017) "Mechanics and modeling of cohesive frictional granular materials. In: Ferrari A., Laloui L. (eds) *Advances in Laboratory Testing and Modelling of Soils and Shales (ATMSS). ATMSS 2017.* Springer Series in Geomechanics and Geoengineering. Springer, Cham.

Singh S., Miers J.C., Saldana C.J., and Murthy T. G., (2018) "Experiments show a second length scale in weakly cohered granular materials", *In micro to MACRO Mathematical Modelling in Soil Mechanics*, (pp. 319-326). Birkhäuser, Cham.

INTERNATIONAL CONFERENCES

Singh S., Miers J.C., Saldana C.J., and Murthy T. G., (2018) "Structure of cohesive frictional granular materials", *10th European Solid Mechanics Conference*, Bologna, Italy.

Singh S., Miers J.C., Saldana C.J., and Murthy T. G., (2018) "Measurement of fabric in cohesive frictional granular materials using computed tomography", *IS Atlanta*, Atlanta, United States.

Singh S., Hegde A., and Murthy T. G., (2018) "On the depositional fabric of granular ensembles", *International Union of Theoretical and Applied Mechanics, IIT Kanpur*, Kanpur, India.

Hegde A., **Singh S.**, and Murthy T. G., (2019) "Random packings – insight from micro-computed tomography and contact dynamics", *Engineering Mechanics Institute Conference, CalTech*, Pasadena, California, United States.

Singh S. and Murthy T. G., (2019) "Weakly cemented sands: understanding at multiple length scales ", 7^{th} *International Congress on Computational Mechanics and Simulation, IIT Mandi*, Mandi, India.

Singh S. and Murthy T. G., (2022) "Structure of cemented granular materials", 20^{th} *International Conference on Soil Mechanics and Geotechnical Engineering*, Sydney, Australia.

Singh S., Bhat M., Murthy T. G., and Natarajan V., (2022) "Morse theory based segmentation of angular sands", 5^{th} *International Conference on Tomography of Materials and Structures*, Grenoble, France.

NATIONAL CONFERENCES

Singh S., Yadav S., and Murthy T.G., (Dec 2014) "Deformation fields in 1-g model tests of footing on granular ensemble", *Indian Geotechnical Conference*, JNTU Kakinada, India.

Kandasami R. K., **Singh S.**, and Murthy T. G., (Dec 2016) "Calibration and validation of Lade's constitutive model for weakly cemented sands", *Indian Geotechnical Conference*, IIT Madras, India.

Bhat M., **Singh S.**, and Murthy T.G., (July 2019) "Statistical study on spatial randomness of cemented granular particles", *Indian Conference on Applied Mechanics*, IISc Bangalore, India.