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Research Interests

○ Multi-scale and multi-physics modeling ○ Granular Flow ○ Large Deformation Analysis ○ Limit and Shakedown analysis ○ Advanced discretization techniques (SFEM, meshless method, Adaptive FEM, PolyFEM) ○ Constitutive Modelling

Academic Background

Program	Institution	%/CGPA	Year
Ph.D. (Civil Engineering)	Indian Institute of Science Bangalore	6.7/8.0	2015-2020
M.Tech. (Distinction) (Earthquake Engineering)	Indian Institute of Technology Roorkee	9.0/10.0	2012-2014
B.Tech. (Distinction) (Civil Engineering)	Indira Gandhi Institute of Technology Sarang, Odisha	8.7/10.0	2008-2012

Publications

Journal papers: Published/ Accepted.....

1. **Mohapatra D**, Kumar J, Kinematic limit analysis for clays with anisotropy and different strengths in compression and tension, **Computers and Geotechnics** 2020 (Accepted).
2. **Mohapatra D**, Kumar J. Bearing capacity of embedded foundations using quasi-kinematic limit analysis. **Computers and Geotechnics**, 117(2020): 10.1016/j.compgeo.2019.103275
3. **Mohapatra D**, Kumar J. Smoothed finite element approach for kinematic limit analysis of cohesive frictional materials. **European Journal of Mechanics-A/ Solids** 2019; 76: 328-345. (One of the most popular article of Journal in August, 2019)
4. **Mohapatra D**, Kumar J. Collapse loads for rectangular foundations by three-dimensional upper bound limit analysis using radial point interpolation method. **International Journal for Numerical and Analytical Methods in Geomechanics** 2019; 43(2): 641-660. (One of the most read paper in 2018 and 2019 of the IJNMG)

5. **Mohapatra D**, Kumar J. Upper bound finite elements limit analysis of axisymmetric problems for Mohr-coulomb materials using semidefinite programming. *Journal of Engineering Mechanics, ASCE* 2018; 144(7):10.1061/(ASCE)EM.1943-7889.0001472.
6. Kumar J, **Mohapatra D**. Closure to “Lower-Bound Finite Elements Limit Analysis for Hoek-Brown Materials Using Semidefinite Programming” by Jyant Kumar and Debasis Mohapatra. *Journal of Engineering Mechanics, ASCE* 2018; 144(7): 10.1061/(ASCE)EM. 1943-7889.0001486.
7. Kumar J, **Mohapatra D**. Lower-Bound Finite Elements Limit Analysis for Hoek-Brown Materials Using Semidefinite Programming. *Journal of Engineering Mechanics, ASCE* 2017; 143(9): 10.1061/(ASCE)EM.1943-7889.0001486.

Journal papers: Under Review/ Under Preparation.....

8. **Mohapatra D**, Kumar J, Stability analysis of an embankment over soft clay reinforced with granular columns using homogenization based kinematic limit analysis approach, under review, *International Journal for Numerical and Analytical Methods in Geomechanics*, 2020.
9. **Mohapatra D**, Kumar J, A ploytree-based adaptive approach for limit and shakedown analysis of cohesive-frictional material, to be communicated.

Conferences.....

10. **Mohapatra D**, Kumar J. Numerical assessment of the macroscopic strength criterion of reinforced soils and its implementation to stability analysis using homogenization based limit analysis approach. **4th Indian Conference on Applied Mechanics 2019**, at Indian Institute of Science, Bangalore, India.
11. **Mohapatra D**, Kumar J. An adaptive mesh based finite element limit analysis approach for geo-mechanics problems. **Indian Geotechnical Conference-2018**, at Indian Institute of Science, Bangalore, India. (Best presenter Award)
12. Rahaman O, **Mohapatra D**, Kumar J. Bearing capacity of piles in non-homogeneous clay using conic programming. **Indian Geotechnical Conference-2018**, at Indian Institute of Science, Bangalore, India.
13. **Mohapatra D**. A Parametric investigation into modelling of unbounded domain using perfectly matched layer, **7th Annual Student Symposium-2014**, at Indian Institute of Science, Bangalore, India.
14. **Mohapatra D**. Numerical formulations for large scale plasticity problems using Limit analysis : implementation to geo-mechanics, **Invited Talk, at Indian Institute of Technology Roorkee (IITR)**, 28th Feb, 2020.

Skills

- **Languages :** C++, Matlab, Python, TCL
- **Documentation & Graphics:** LATEX, ParaView, Photoshop
- **Softwares:** OpenSees, Triangle, TetGen, Gmsh, PolyMesher, YADE
- **Elemental soil testing**

Research Experience

1. Indian Institute of Science, Bangalore

July, 2015-2020

Research Scholar in Civil Engineering

Thesis: Novel numerical procedures for limit analysis: implementation to planar, axisymmetric and three-dimensional geomechanics stability problems

Supervisor: Prof. Jyant Kumar

Research Focus:

Current research in the field of computational limit analysis focuses on the development of numerical tools which are sufficiently efficient and robust to be used in engineering practices. This places demands on the numerical discretization strategy adopted as well as on the mathematical programming tools applied, which are the key ingredients of a typical computational limit analysis procedure. The three major objectives of present research work are (i) to improve the accuracy and efficiency of limit analysis solutions using advanced spatial discretization techniques, (ii) to express the optimization problems associated with numerical limit analysis to be solved by advanced optimization techniques, so that it can be solved efficiently, and (iii) to solve complicated 2D and 3D geomechanics problems using above numerical techniques.

Major Research Outputs:

- **Mesh-free method, Smoothed finite element methods (S-FEM), Cell-based smoothed finite element method (CS-FEM) and Polytree based Finite Element method** along with mesh adaptive techniques have been used to formulate limit analysis optimization problem for cohesive-frictional materials.
- The associated numerical optimization problems of limit analysis are nonlinear, non-differentiable and sparse in nature. The conic programming second order cone programming (**SOCP**) and semidefinite programming (**SDP**) along with primal-dual interpolation method is found to be best approach to solve this type of problems. In this research, by using mathematical theories, numerical optimization problems associated with different limit analysis problems are expressed in the form of **SOCP** and **SDP**.
- In order to solve complex 3D problems like embankment resting on stone column reinforced soil, **homogenization** based limit analysis has been used. In this procedure, yield surface of soil-stone column composite is obtained numerically by solving an auxiliary limit analysis problem associated with selected **Representative Volume Element (RVE)**. The obtained yield surface is then approximated as the sum of convex ellipsoidal sets. The approximated numerical yield criterion has been used as yield function of stone column reinforced soil, while solving the embankment resting on stone column reinforced soil problem. Stability number charts have been provided for different soil and reinforced parameters, geometry of embankment and different percentage of reinforcements.

- Using the above developed formulations complex 3D problems of geo-mechanics, like: (a) bearing capacity of rectangular foundation at ground surface (b) bearing capacity of embedded footings and (c) Stability analysis of embankment on stone column reinforced soils, have been solved and new updated results of these complicated problems are provided in chart form, which can be used by geotechnical engineers.

2. Indian Institute of Technology, Roorkee

July, 2012-June, 2014

M.Tech. in Earthquake Engineering

Thesis: A Parametric investigation into modelling of unbounded domain using perfectly matched layer

Supervisor: Prof. Manish Shrikhande

Research Focus:

This work was mainly focused to implement Perfectly Matched Layer (PML) concept of modelling unbounded domain to **Opensees** framework and to study the effect of different PML parameters on obtained results.

Major Research Outputs:

- A new material code named **PMLmaterial** and a new element code named **PMLelement** have been written in C++, in **Opensees** compatible format using **Polymorphism** and **Inheritance** properties of C++ and added to **Opensees** framework to model the unbounded domain using PML. These files can be found <https://github.com/debasismpt125/PML>.
- The model results have been verified by solving a shallow foundation resting on unbounded domain, subjected to dynamic loading problem. Numerical studies have been carried out to see the effect of soil domain, thickness of PML layer and different parameters involved in modelling PML layer.

3. Indian Institute of Science, Bangalore

July, 2014-June, 2015

Junior Research Fellow

This was a Department of Science and Technology (DST) funded project to carry out experimental study of a site using MASW testing.

Teaching Experience

Involved in conducting tutorial classes, formulating assignments and grading exam papers

1. Department of Civil Engineering, Indian Institute of Science Bangalore

Teaching Assistant

- CE 205 3:0 Finite Element and mesh-free Methods, Instructor: Prof. Debashish Roy
- CE 206 3:0 Earth and Earth Retaining Structures, Instructor: Prof. Jyant Kumar
- CE 219 2:0 Soil Dynamics, Instructor: Prof. Jyant Kumar

2. Department of Earthquake Engineering, Indian Institute of Technology Roorkee

- EQ-504 4:0 Finite Element Method, Instructor: Prof. Manish Shrikhande

Awards and Scholarships

- “Lower-Bound Finite Elements Limit Analysis for Hoek-Brown Materials Using Semidefinite Programming” Journal of Engineering Mechanics, #ASCE, has been adjudged as the best paper on “Rock Mechanics and Rock Engineering” for **IGS-Roorkee Chapter YGE Award-2019**.
- **Best Presenter Award** at the Indian Geotechnical Conference 2018 (IGC-2018)
- My article has been recognized as one of **the most read in International Journal for Numerical and Analytical Methods in Geomechanics** for years 2017-18 and 2018-19
- First Division with Distinction in B.Tech. and M.Tech.
- Secured 1st position in Resonance (Quiz Competition), Department of Earthquake Engineering, during COGNIZANCE 2013, of IIT Roorkee,
- Received Ministry of Human Resource Development (MHRD), Government of India Scholarship to Pursue M.Tech. and Ph.D.
- State Govt. merit Scholarship in undergraduate
- Secured 1st position in Bridge Design competition

Professional Activities

Committee Membership.....

- President, **IGS-IISC Young Members Chapter**, (April, 2019-Present)
- Life member: (ID: LM4131), **Indian Geotechnical Society, (IGS)**
- Student member:(ID: 020838858), **Society for Industrial and Applied Mechanics, (SIAM)**
- Member : (ID: 020838858), **IISc-SIAM Student Chapter**
- Student member: **International Association for Computer Methods and Advances in Geomechanics (IACMAG)**

Training and Workshops

- Workshop-Short term course on **Soil Physics using Python** at Department of Civil Engineering, Indian Institute of Science, Bangalore from 23rd April, 2018 to 27th April, 2018.
- Pre-conference workshop of 4th Indian Conference on Applied Mechanics on **Plasticity and Damage Mechanics** at Indian Institute of Science, Bangalore on 2nd June, 2019.
- Udeemy online course on **The Complete Python Masterclass: Learn Python From Scratch**, in August, 2019
- Workshop on **How to do Outstanding Research** at ECE Department, Indian Institute of Science, Bangalore on 12th May, 2018.
- Training courses on **C++, AutoCAD and STAAD. Pro.** did in my under-graduation.

Organizing Conferences and Workshops.....

- Organizing committee member of Indian Geotechnical Conference-2018 (IGC-2018)
- Organizing committee member of IGC-2018 on preconference workshop on Recent Advances in Soil-Structure Interactions and Retaining Walls

- Organizing committee member of Openday 2015, 2017, 2018 and 2019 at IISc

Reviewer of Journals.....

- Computers and Geotechnics
- Ocean Engineering

Relevant courses credited or audited

- Continuum Mechanics
- Finite Element and Mesh-free Methods
- Nonlinear Finite Element Method
- Variational Methods and Structural Optimization
- Numerical Methods
- Convex Optimization
- Theory of Vibration
- Soil Dynamics and Geotechnical Earthquake Engineering
- Soil-Structure Interaction
- Monte-carlo simulation in structural engineering

Personal Details

- **Date of Birth:** 7th June, 1991
- **Father's Name:** Nilakantha Mohapatra
- **Mother's Name:** Josna Mohapatra
- **Languages Known:** English, Hindi, Odia

References

- **Prof. Jyant Kumar**, Professor, Dept of Civil Engineering, Indian Institute of Science, Bangalore 560012.
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- **Prof. Manish Shrikhande**, Professor, Department of earthquake engineering, Indian Institute of Technology, Roorkee, Roorkee-257667. Cell: +91 9412071738. Email: manish.shrikhande@eq.iitr.ac.in
Website : <https://eq.iitr.ac.in/pages/people+faculty+mshrifefq.html>
- **Dr. Debraj Ghosh**, Associate Professor, Dept. of Civil Engineering, Indian Institute of Science, Bangalore
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