Abhishek Chatterjee

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EDUCATION

Doctor of Philosophy, Mechanical Engineering - August, 2015 - August, 2019
University of Texas at Arlington, Arlington, TX
- Dissertation: *"Modeling and Simulation of Contact and Impact Dynamics in Multibody Systems"*
- Advisor: Dr. Alan Bowling

Master of Science, Mechanical Engineering - August, 2013 - May, 2015
University of Texas at Arlington, Arlington, TX
- Thesis: *"Three-dimensional Indeterminate Impacts in Legged Robotic Locomotion"*
- Advisor: Dr. Alan Bowling

Bachelor of Science, Mechanical Engineering (Cum Laude) - August, 2009 - May, 2013
Midwestern State University, Wichita Falls, TX
- Minor: Physics and Mathematics
- Senior Design: *"Active Road Rumble Energy Harvesting Panels"*

Graduate Certificate in Unmanned Vehicle Systems - May, 2019
University of Texas at Arlington, Arlington, TX

Relevant Courses: Intelligent Control, Optimal Control of Dynamic Systems, Structural Dynamics, Optimal Estimation of Dynamic Systems, Unmanned Vehicle Systems Development, Introduction to Unmanned Vehicle Systems, Analytical and Computational Dynamics, Design of Digital Control System, Dynamic Systems Modeling and Simulation, Introduction to Robotics, Control Systems, Numerical Analysis

RESEARCH INTEREST

Multibody Dynamics, Robotics, Contact and Impact Dynamics, Optimal/Intelligent Control, Flexible Body Dynamics and FEM, Modeling and Simulation

RESEARCH EXPERIENCE

Tripop Team,
Institut national de recherche en informatique et en automatique (INRIA) Grenoble Rhône - Alpes, Grenoble, France (Sep 2020 - Current)
- Modeling and analysis of multiple-impacts with external loads.
  - Analysis of dynamic behavior of granular chain of beads under multiple-impacts based on Kwabra-Kono model.
  - Study the effects of external loads (such as gravity) in the impact model.

Machine Performance Analysis Group, Innovation Technology & Digital Design Division,
Caterpillar .Inc, Mossville - Peoria, IL (Feb 2020 - April 2020)
- Development and analysis work directed towards Caterpillar's *Virtual Product Development* efforts.
  - Development and maintenance company's in-house Multibody Dynamics (MBD) simulation software.
  - Development of a new software application to automate damping parameter estimation for flexible body models using mechanical testing data.
  - Comparative study and analysis of internal Finite Element Analysis (FEA)/Multibody Dynamics (MBD) simulation software with an industry-standard legacy software application known as NASTRAN.
  - Study of company's internal Discrete Element Method (DEM) codes for soil/gravel simulation.

Robotics, Biomechanics and Dynamic Systems Laboratory ,
University of Texas at Arlington, Arlington, TX (August 2013 - Jan 2020)
- Modeling and Simulation of Flexible-Body Contact and Impact
  - Developed a method for modeling contacts and impacts between soft(flexible) bodies within a multibody dynamic simulation framework by using a lumped-parameter approach.
  - The method combines modal approach along with constrained multibody dynamic simulation approach to yield a unified model for flexible contact and impact.
  - The model developed as part of this work is being used to model the dynamics of a pressure-actuated hospital bed.
- Force Estimation during (pseudo)-rigid collisions [*in collaboration with Rice University*]

- Developed a method for determining approximate force and deformation histories during rigid body collisions characterized by an energetic coefficient of restitution.
- A rigid collision model is augmented with an elastoplastic force model to yield an efficient simulation framework for simultaneous computation of deformation and force histories along with the post-impact states.
- 3D Rigid Surface-to-Surface Contact and Impact Modeling
  - Developed a novel method for modeling surface-surface contacts and impacts in rigid body system that improved upon the various existing models by addressing multi-point stick-slip transition, and guaranteeing system-level energy consistency.
  - The method uses a hybrid dynamic simulation approach where a coordinate partitioning based constraint enforcement method is used to simulate the free and contact constrained dynamics and an energetically consistent impact model is to reset the states upon collision detection.
- Planar Rigid Body Contact and Impact Modeling
  - Developed a planar model for multi-point collision was developed for rigid body system
  - A method for transitioning between contact and impact, in a hybrid dynamic simulation setting, for chatter (Zeno phenomenon) avoidance
  - Planar contact and impact model developed here is being used to study rocking response of structures subjected to seismic excitation.
- Simulation of ATLAS bipedal robot while modeling foot-ground collisions
  - Applied a 3D multi-point collision modeling technique to model and simulate the walking motion of ATLAS bipedal robot.

Department of Mechanical Engineering,
Midwestern State University, Wichita Falls, TX (May 2011 - May 2013)
- Mathematical modeling and prototyping of Rumble-Strip Energy Harvester [*Senior Design Project*]
  - Developed mathematical model of a rumble-strip based energy harvesting system
  - Design optimization to maximize energy output and prototyping a working model
- Campus Energy Study [*as a part of UGROW program*]
  - A feasibility study on various energy harvesting technologies to be implemented on Midwestern State University campus

WORK
EXPERIENCE

Postdoctoral Researcher, Tripop Team,
Institut national de recherche en informatique et en automatique (INRIA) Grenoble Rhône - Alpes, Grenoble, France (Sep 2020 - Current)
  Application oriented research and development work related to Caterpillar's *Virtual Product Development* effort that facilitate various internal product groups

Engineer - Performance/Simulation/Application, Innovation Technology & Digital Design Division,
Caterpillar .Inc, Mossville - Peoria, IL (Feb 2020 - April 2020)
  Application oriented research and development work related to Caterpillar's *Virtual Product Development* effort that facilitate various internal product groups

Graduate Research Assistant (Data Research and Analysis), Office of the Provost,
University of Texas at Arlington, Arlington, TX (August 2018 - May 2019)
  Performed data research and analysis to assist in university policy and decision making.

Graduate Teaching Assistant, Mechanical and Aerospace Engineering Department,
University of Texas at Arlington (August 2015 - May 2018)
  Provided feedback to students by grading homeworks and lab reports. Taught lab sections, gave occasional in-class lectures, and conducted office hours to assist in the student's learning.

Tutor, Department of Mechanical Engineering,
Midwestern State University, Wichita Falls, TX (January 2012 - May 2012)
  Tutoring fellow Mechanical Engineering students for freshman-junior level classes.

Teaching Assistant, Department of Physics,
Midwestern State University, Wichita Falls, TX (June 2011 - December 2012)
  Teaching and grading freshman Physics Labs.

Student Assistant, Department of Mechanical Engineering,
Midwestern State University, Wichita Falls, TX (January 2010 - December 2010)

Preparing lab handouts and setting up lab equipment for Measurement and Instrumentation Lab.

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<tr><td>Honors & Awards</td><td>

- Lawrence W. Stephens Endowed Scholarship, University of Texas at Arlington   June 2019
- Summer Dissertation Fellowship, University of Texas at Arlington   June-August 2019
- STEM Doctoral Fellowship, University of Texas at Arlington   2015-2019
- Mechanical and Aerospace Engineering STEM Fellowship, University of Texas at Arlington 2015-2019
- ASME 2018 MSNDC Conference Student Travel Grant   October 2018
- Nominated as a finalist to MSNDC *Best Student Paper Competition* at ASME IDETC/CIE 2018   July 2018
- *Academic Honor Societies:* Pi Mu Epsilon (2011), Alpha Chi (2011), Alpha Lambda Delta (2010), and Phi Eta Sigma (2010)
- *Honor Roll:* Midwestern State University President's Honor Roll (2009), Dean's Honor Roll (2010), and Provost's Honor Roll (2012)
- *Scholarships:* McCoy School of Engineering Scholarship (Fall, 2009 - Spring, 2013), MSU UGROW scholarship (Summer 2011)

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Skills

Technical: Multibody Dynamics, Contact and Impact Dynamics, Kinematics, Classical and Optimal Control Techniques, Static/Dynamic Optimization, Numerical Method
Computer: C/C++, Python, MATLAB/Simulink, SolidWorks, LabView, NASTRAN
Hardware: NI myRIO, NI DAQ, Arduino

Publications

Journal

1. **Abhishek Chatterjee**, Rashi Jain, and Alan Bowling. "*Modeling and Simulation of Rocking Block Dynamics subjected to Base Motion using an Energetic Restitution Law*". Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, (Under Review)
2. **Abhishek Chatterjee**, Hamid Ghaednia, Alan Bowling and, Matthew Brake. "*Estimation of Impact Forces during Multi-point Collisions involving Small Deformations*". Multibody System Dynamics, (Accepted, In Press).
3. **Abhishek Chatterjee**, and Alan Bowling. "*Modeling three-dimensional surface-to-surface rigid contact and impact*". Multibody System Dynamics, vol. 46, no. 1, pages 1-40, May 2019.
4. **Abhishek Chatterjee**, Adrian Rodriguez and Alan Bowling. "*Analytic solution for planar indeterminate impact*". Multibody System Dynamics, vol. 42, no. 3, pages 347-379, March 2018.

Conference

1. **Abhishek Chatterjee**, Alan Bowling, Hamid Ghaednia and, Matthew Brake. "*Approximate Force History Estimation In Multi-Point Non-Smooth Collisions*". ASME 2019 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC/CIE), August 18-21, 2019. Anaheim, California.
2. **Abhishek Chatterjee** and Alan Bowling. "*Resolving the Unique Invariant Slip-Direction in Rigid Three-Dimensional Multi-Point Impacts at Stick-Slip Transitions*". ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference (IDETC/CIE), August 26-29, 2018. Quebéc City, Quebéc, Canada.
3. **Abhishek Chatterjee** and Alan Bowling. "*Modeling Rigid Body Multi-Point Contact-Impact Transition for Event-Based Simulation*". 8th ECCOMAS Thematic conference on Multibody Dynamics, June 19-22, 2017. Prague, Czech Republic.
4. **Abhishek Chatterjee** and Alan Bowling. "*Analysis of Three Dimensional Indeterminate Impacts using Rigid Body Constraints*". 4th International conference on Multibody Dynamics (IMSD), May 29 - June 2, 2016. McGill University, Montreal, Québec, Canada.
5. Adrian Rodriguez, **Abhishek Chatterjee** and Alan Bowling. "*Solution to three-dimensional indeterminate contact and impact with friction using rigid body constraints*". ASME 2015 International Design Engineering Technical Conference (IDETC/CIE), August 2-5, 2015. Boston, Massachusetts, USA.
6. M. Salim Azzouz, **Abhishek Chatterjee**, Robert Rorabaugh, Christopher Venegas, Krista Duke, John Mark Weller and Chris Smith. "*Active Road Rumble Energy Harvesting Panels*". ASME 2013 International Mechanical Engineering Congress and Exposition (IMECE), November 15-21, 2013. San Diego, California, USA.

Dissertation/Thesis

1. **Abhishek Chatterjee**. "*Modeling and Simulation of Contact and Impact Dynamics in Multibody Systems*". Dissertation & Theses University of Texas - Arlington; ProQuest Dissertation & Theses Global.

2. **Abhishek Chatterjee**. "*Three-dimensional indeterminate impacts in legged robotic locomotion*". Dissertation & Theses University of Texas - Arlington; ProQuest Dissertation & Theses Global.

PRESENTATIONS **Oral**

- "*Approximate Force History Estimation In Multi-Point Non-Smooth Collisions*". ASME IDETC/CIE 2019, Anaheim, California, 2019.
- "*Resolving the Unique Invariant Slip-Direction in Rigid Three-Dimensional Multi-Point Impacts at Stick-Slip Transitions*". ASME IDETC/CIE 2018, Quebéc City, Quebéc, Canada., 2018. (**Presented twice: 1 regular conference presentation and 1 competition presentation**)
- "*Modeling Surface to Surface Impacts*". MAE Brown Bag Seminar Series, University of Texas at Arlington, Arlington, TX, 2017.
- "*Resolving Indeterminate, Simultaneous Three-Dimensional Multipoint Contact and Impact with Friction*". MAE Brown Bag Seminar Series, University of Texas at Arlington, Arlington, TX, 2016.
- "*Solutions to Three-Dimensional Indeterminate Contact and Impact with friction using Rigid Body Constraint*". ASME IDETC/CIE, Boston, MA, 2015.
- "*Three-Dimensional Indeterminate Impacts in Legged Robotic Locomotion*", MAE Brown Bag Seminar Series, University of Texas at Arlington, Arlington, TX, 2015.
- "*Humanoid Robot Locomotion*". MAE Brown Bag Seminar Series, University of Texas at Arlington, Arlington, TX, 2014
- "*Active Road Rumble Energy Harvesting Panels*". IDEA MSU, Midwestern State University, Wichita Falls, TX, 2013
- "*Harvesting Energy at MSU*". North-Texas Area Student Conference, Midwestern State University, Wichita Falls, TX, 2012.
- "*Harvesting Energy at MSU*", Texas Academy of Science, Sul Ross University, Alpine, TX, 2012.

Poster

- "*Multibody Contact and Impact Analysis and Transition*". The 13th Annual Celebration of Excellence by Students (ACES), Symposium, University of Texas at Arlington, Arlington, TX, Fall 2017
- "*Three Dimensional Indeterminate Impacts Using Rigid Body Constraints*". The 12th Annual Celebration of Excellence by Students (ACES), Symposium, University of Texas at Arlington, Arlington, TX, 2016.

REFERENCES **Dr. Alan Bowling**
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