

# STEPHEN G. BERARD

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## Address

Troy, NY 12180

## EDUCATION

*Ph.D.*, Computer Science  
Rensselaer Polytechnic Institute, Troy, NY May 2009

*Bachelor's Degree*, Mathematics and Computer Science  
Clark University, Worcester, MA May 2003

## DISSERTATION

**Advisor:** Jeffrey Trinkle

**Title:** Using Simulation for Planning and Design of Robotic Systems with Intermittent Contact

**Summary:** We first develop four new time-stepping methods. These time-steppers were constructed for a variety of reasons, including accuracy, performance, and design. Next, a discussion on a simulation software package (dubbed daVinci Code) we developed is given. This software tool facilitates the simulation, analysis, and virtual design of multibody systems with intermittent frictional unilateral contact. Next, we performed a numerical study on the accuracy of our methods, and experimentally validated our time-stepper on a system composed of a vibrating rigid plate and interacting part. With the accuracy of our time-stepper verified for this system, we were able to study the inverse problem of designing new plate motions to generate a desired part motion. Lastly, we present our initial results of a new non-recursive nonlinear filter. This filter allows us to estimate the system's parameters, which is a necessary requirement for using simulation for planning and design. The filtering problem is particularly challenging, since the underlying mathematical model is nonsmooth.

## RESEARCH AND PROFESSIONAL EXPERIENCE

**Graduate Research Assistant**, Dept. of Computer Science, RPI, Troy, NY 2003 - Present

**Technical Intern**, Raytheon Electronic Systems, Tewksbury, MA Summer 2001

## TEACHING EXPERIENCE

**Teaching Assistant**, Computer Science II, RPI, Troy, NY Spring 2009, Fall 2007  
CS2 is a course in elementary data structures and their use in programming. Conducted weekly lab section.

**Teaching Assistant**, Data Structures and Algorithms, RPI, Troy, NY Spring 2007  
Conducted weekly lab section.

**Teaching Assistant**, Three-Dimensional Computer Graphics, RPI, Troy, NY Fall 2006

## PUBLICATIONS

### Book Chapters

- [1] Kevin Egan, Stephen Berard, and Jeffrey C. Trinkle. *Toward Sensorless Acquisition of Multiple Contact Points Between Planar Parts*, pages 113-131. Number 18 in STAR - Springer Tracts in Advanced Robotics. Springer Berlin / Heidelberg, 2005. Workshop on Multi-point Interaction in Robotics and Virtual Reality

### Refereed Journal Articles

- [1] N. Chakraborty, S. Berard, S. Akella, and J. C. Trinkle. An Implicit Time-Stepping Method for Multibody Systems with Intermittent Contact. *International Journal of Robotics Research*, (Submitted).
- [2] Stephen Berard, Binh Nguyen, Kurt Anderson, and J.C. Trinkle. Sources of Error in a Simulation of Rigid Parts on a Vibrating Rigid Plate. *ASME Computational and Nonlinear Dynamics*, (Submitted).

### Papers Under Preparation

- [1] Binh Nguyen, Stephen Berard, J. C. Trinkle. Modeling Nonconvex Configuration Space Using Linear Complementarity Problems.

### Refereed Conference Articles

- [1] Stephen Berard, Binh Nguyen, and J.C. Trinkle. Sources of Error in a Rigid Body Simulation of Rigid Parts on a Vibrating Rigid Plate. In *ACM Symposium on Applied Computing*, May 2009.
- [2] N. Chakraborty, S. Berard, S. Akella, and J.C. Trinkle. An implicit compliant model for multibody systems with frictional intermittent contact. In *ASME International Design Engineering Technical Conferences*, October 2007.
- [3] N. Chakraborty, S. Berard, S. Akella, and J.C. Trinkle. An implicit time-stepping method for multibody systems with intermittent contact. In *Robotics: Science and Systems*, June 2007. **Best Student Paper Award.**
- [4] Stephen Berard, Jeff Trinkle, Binh Nguyen, Benjamin Roghani, Vijay Kumar, and Jonathan Fink. daVinci code: A multi-model simulation and analysis tool for multi-body systems. In *IEEE International Conference on Robotics and Automation*, pages 2588-2593, April 2007.
- [5] J.C. Trinkle, Stephen Berard, and J.S. Pang. A time-stepping scheme for quasistatic multibody systems. In *IEEE International Symposium on Assembly and Task Planning*, pages 174 - 181, March 2005.
- [6] Stephen Berard, Kevin Egan, and J. C. Trinkle. Contact modes and complementary cones. In *IEEE International Conference on Robotics and Automation*, pages 5280 - 5286, April 2004.

### Non-Refereed Articles

- [1] Stephen Berard, Binh Nguyen, Kurt Anderson, and J.C. Trinkle. Sources of error in a simulation of rigid parts on a vibrating rigid plate. Technical Report 08-10, Department of Computer Science, Rensselaer Polytechnic Institute, 2008.
- [2] Stephen Berard. Cooking with complementarity: A recipe guide for complementarity based rigid-multibody dynamics simulation. Technical Report 06-08, Department of Computer Science, Rensselaer Polytechnic Institute, 2006.
- [3] K.T. Egan, Stephen Berard, and J.C. Trinkle. Modeling nonconvex constraints using linear complementarity. Technical Report 03-13, Department of Computer Science, Rensselaer Polytechnic Institute, 2003.
- [4] K.T. Egan, Stephen Berard, and J.C. Trinkle. Computing wrench bounds along a curved surface in 2d. Technical Report 04-09, Department of Computer Science, Rensselaer Polytechnic Institute, 2004.

## PRESENTATIONS

- [1] Using Simulation for Planning and Design of Robotic Systems with Intermittent Contact. *Computer Science Colloquium, Williams College, Williamstown, MA.* November 2008.
- [2] Stephen Berard. An MPEC Formulation for Parameter Identification of Complementarity Systems. *New England Manipulation Symposium, Providence, RI.* June 2008.
- [3] Stephen Berard. Identification of Physical Parameters of Rigid Body Systems. *Workshop on Contact Models for Manipulation and Locomotion, Pasadena, CA.* May 2008.
- [4] N. Chakraborty, S. Berard, S. Akella, and J.C. Trinkle. Two new fully implicit time-stepping schemes for multibody systems with intermittent contact. In *International Conference Continuous Optimization*, August 2007. (abstract with presentation by N. Chakraborty).
- [5] Stephen Berard. Simulation and Analysis with daVinci Code. *New England Manipulation Symposium, Troy, NY.* June 2007.
- [6] Stephen Berard and Jeff Trinkle. daVinci Code: A Multi-Model Simulation and Analysis Tool for Multi-Body Systems. *New England Manipulation Symposium, Amherst, MA.* June 2006.

## PROJECTS

*daVinci Code (dVC)* Implemented and maintain a new physical simulation library capable of accurately simulating and animating systems of bodies experiencing intermittent and steady unilateral contacts. Used in research at RPI and UPENN and classes at RPI and Northwestern.

## HONORS

Best Student Paper, Robotics: Science and Systems	2007
PHI BETA KAPPA National Honor Society	2003

## TECHNICAL SKILLS

*Languages* (In order of proficiency): C++, C, Java, L<sup>A</sup>T<sub>E</sub>X, BASH, and Scheme  
*Software*: Linux, UNIX, Windows, gcc/g++, gdb, valgrind, STL, OpenGL

## SERVICE

Student Member of Computing Committee, RPI Dept of Computer Science, Troy NY	2005
Undergraduate Recruiting, RPI Dept of Computer Science, Troy NY	2003-2008
Organized Departmental mixers, RPI Dept of Computer Science, Troy NY	2003-2008
Volunteer Tutor, Clark University Dept of Math and Computer Science, Worcester Ma	2002 - 2003

**Peer Reviews:** IEEE Transactions on Robotics, International Journal of Robotics Research, ACM SIG-GRAPH, ASME International conference on Multibody Systems, Nonlinear Dynamics and Control, IEEE Conference on Automation Science and Engineering, IEEE International Conference on Robotics and Automation, IEEE/RSJ International Conference on Intelligent Robots and Systems, Robotics: Science and Systems Conference