Ricardo Taborda

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Research Interests

My research focuses on problems related to earthquake engineering with a multidisciplinary end-to-end approach that combines topics of structural mechanics, geotechnical and structural engineering, seismology, wave propagation, numerical methods, and computer science. The latest results of my research show the potential of deterministic, physics-based earthquake simulations for seismic hazard analysis at frequencies of engineering interest. In recent years I have applied high-performance parallel computing to solving earthquake simulations combining nonlinear soil response in basins and the effect of the urban environment at regional scales, using finite elements. I have also been involved in research projects related to problems of soil-structure interaction, full-scale tests, instrumented structures, system-identification techniques, health monitoring analysis, damage detection using wavelets transforms, and signal processing and analysis of strong ground-motion records.

Education

2005 – 2010 Ph.D., Civil and Environmental Engineering
Carnegie Mellon University
Thesis: Three Dimensional Nonlinear Soil and Site-City Effects in Urban Regions
Advisor: Prof. Jacobo Bielak
GPA: 3.80/4.00

2004 – 2005 M.Sc., Civil Engineering, Structural Mechanics
University of Southern California
GPA: 3.93/4.00

2000 – 2003 M.Sc., Civil Engineering, Structural Engineering
National Autonomous University of Mexico (UNAM)
Thesis: Dynamic response and soil-structure interaction effects of an instrumented building in Acapulco City (in Spanish)
Advisor: David Murià-Vila
GPA: 9.67/10.0

1995 – 2000 EAFIT University, Medellín, Colombia
B.Sc., Civil Engineering
GPA: 4.33/5.00

Current and Previous Positions

2010 –	Postdoctoral Research Associate, Computational Seismology Laboratory, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA.
2005 – 2010	Graduate Research and Teaching Assistant, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA.
2004 – 2005	Graduate Research and Teaching Assistant, Civil and Environmental Engineering, University of Southern California, Los Angeles, CA.
2000 – 2003	Graduate Research Assistant, Institute of Engineering, National Autonomous University of Mexico, Mexico City, Mexico.
1999 – 2000	Engineer, Quality Division, Technical Department, ConConcreto S.A., Envigado, Colombia.
1997	Teaching Assistant, Civil Engineering Department, EAFIT University, Medellín, Colombia.

Teaching Experience

Instructor:

Finite Elements in Mechanics I (12-755/24-755). Co-Instructor with Dr. Antonio Fernandez-Ares (Prof. Jacobo Bielak, Instructor of Record). Graduate Course. Carnegie Mellon University. Fall 2010.

Guest Lecturer:

Finite Elements in Mechanics I (12-755/24-755). Selected lectures on behalf of Prof. Jacobo Bielak. Graduate Course. Carnegie Mellon University. Fall 2011.

Structural Dynamics. Selected lectures on soil-structure interaction and other topics in structural dynamics, on behalf of Prof. Mario Ordaz. Graduate Course. National Autonomous University of Mexico. Fall 2003.

Teaching Assistant:

Solid Mechanics (12-231). Undergraduate. Civil and Environmental Engineering. Carnegie Mellon University. Spring 2009.

Structural Design (12-631). Undergraduate Course. Civil and Environmental Engineering. Carnegie Mellon University. Spring 2006, 2007, 2008.

Mechanics of Deformable Bodies (CE-225). Undergraduate Course. Civil and Environmental Engineering. University of Southern California. Spring 2004, 2005.

Teaching Experience (continued)

Statics (CE-205). Undergraduate Course. Civil and Environmental Engineering. University of Southern California. Fall 2004.

Structural Analysis I. Undergraduate Course. Civil Engineering. EAFIT University. AY 1996.

Honors & Awards

Mao Yisheng Outstanding Dissertation Award
Outstanding doctoral dissertation in Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, May 15, 2011.

Recipient, Paul P. Christiano Distinguished Service Award
Civil and Environmental Engineering, Carnegie Mellon, Pittsburgh, May, 2010.

Winner, Excellence in Civil Engineering Award
Civil Engineering Alumni Association (AICE), EAFIT University, Medellin, Colombia, October, 2009.

Recipient, Bertucci Graduate Fellowship
Carnegie Mellon University, CIT College of Engineering, 2009–2010.

Winner, 1st EERI Annual Graphics Competition
EERI Annual Meeting, New Orleans, LA, February 6–9, 2008.

Winner, HPC Analytics Challenge (Co-author)
SC06 International Conference for High Performance Computing, Networking, Storage and Analysis, Tampa, FL, November 11–17, 2006.

II-UNAM Thesis Award, High Honors
Institute of Engineering, National Autonomous University of Mexico, December, 2004.

Nominee, Excellence in Civil Engineering Award
Civil Engineering Alumni Association (AICE), EAFIT University, Medellin, Colombia, November, 2004.

Commencement Speaker, School of Engineering
EAFIT University, Medelln, Colombia, June, 2000.

Honor Scholarship, Best Graduate in Civil Engineering
EAFIT University, Medelln, Colombia, June, 2000.

Mention of Honor, Best University Graduate in Leadership and Extracurricular Activities
EAFIT University, Medelln, Colombia, June, 2000.

Leadership Scholarship for Extacurricular Activities
EAFIT University, Medelln, Colombia, Terms: 1998-II, 1999-I, 1999-II and 2000-I.

Honors & Awards (continued)

Honor Scholarship, Best Undergraduate Student in Civil Engineering
EAFIT University, Medelln, Colombia, 1996.

Publications

Reprints, posters, presentations, and companion material are available at:
http://www.ce.cmu.edu/~rtaborda/publications.html

* Peer reviewed before publication.

Journal Papers:

* Bielak, J., Karaoglu, H., and Taborda, R. (2011). Memory-efficient displacement-based internal friction for wave propagation simulation. *Geophysics*, 76(6). In press. [pdf]

* Taborda, R. and Bielak, J. (2011b). Large-scale earthquake simulation — Computational seismology and complex engineering systems. *Computing in Science and Engineering*, 13(4):14–26. [pdf]

* Bielak, J., Graves, R. W., Olsen, K. B., Taborda, R., Ramírez-Guzmán, L., Day, S. M., Ely, G. P., Roten, D., Jordan, T. H., Maechling, P. J., Urbanic, J., Cui, Y., and Juve, G. (2010a). The ShakeOut earthquake scenario: Verification of three simulation sets. *Geophysical Journal International*, 180(1):375–404. [pdf]

Journal Papers in Preparation:

* Taborda, R. and Bielak, J. (2012). Short-Period Ground-Motion Simulation and Validation of the 2008 Chino Hills Earthquake. Progress: 95%. To be submitted to: *Bulletin of the Seismological Society of America*. Expected submission date: End of November, 2011. Current version of the manuscript is available upon request.

* Taborda, R. and Bielak, J. (2012). Nonlinear Soil Effects in Large-Scale Ground-Motion Simulations. Progress: 50%. To be submitted to: *Seismological Research Letters*. Expected submission date: February, 2012.

Thesis:

Taborda, R. (2010). *Three Dimensional Nonlinear Soil and Site-City Effects in Urban Regions*. PhD thesis, Civil and Environmental Engineering, Carnegie Institute of Technology, Carnegie Mellon University, Pittsburgh, PA. [pdf]

Taborda, R. (2003). Dynamic response and soil-structure interaction effects of an instrumented building in Acapulco City (in Spanish). Master's thesis, Graduate School of Engineering, National Autonomous University of Mexico (UNAM). [pdf]

Publications (continued)

Technical Reports:

Taborda, R., López, J., Karaoglu, H., Urbanic, J., and Bielak, J. (2010). Speeding up finite element wave propagation for large-scale earthquake simulations. Technical Report CMU-PDL-10-109, Carnegie Mellon University, Parallel Data Lab. [pdf]

Taborda, R. and Bielak, J. (2008). Three-dimensional modeling of earthquake ground motion in basins, including nonlinear wave propagation in soils. Final Technical Report 08HQGR0018, USGS. [pdf]

Murià-Vila, D., Rodríguez, G., Taborda, R., and Macías, M. (2003b). Dynamic response of the JAL building during the January 21, 2003 Tecomán earthquake (in Spanish). Technical Report Proj. 3516, Institute of Engineering, National Autonomous University of Mexico (II-UNAM).

Murià-Vila, D., Mendoza, M. A., Alcocer, S. M., Taborda, R., and Pérez, R. (2003a). Shake table tests of an electric interrupter with an antiseismic device (in Spanish). Technical Report Proj. 3523, Institute of Engineering, National Autonomous University of Mexico (II-UNAM).

Conference Papers:

Taborda, R. and Bielak, J. (2011a). Full 3D integration of site-city effects in regional scale earthquake simulations. In *Proceedings of the 8th International Conference on Structural Dynamics, EURODYN 2011*, Leuven, Belgium, July 4–6. [pdf]

* Schlosser, S. W., Ryan, M. P., Taborda, R., López, J., O'Hallaron, D., and Bielak, J. (2008). Materialized community ground models for large-scale earthquake simulation. In *SC '08: Proceedings of the 2008 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, page 11, Austin, Texas. IEEE Computer Society. [pdf]

* Yu, H., Tu, T., Bielak, J., Ghattas, O., Lopez, J. C., Ma, K.-L., O'Hallaron, D. R., Ramírez-Guzmán, L., Stone, N., Taborda, R., and Urbanic, J. (2006). Remote runtime steering of integrated terascale simulation and visualization. In *SC '06: Proceedings of the 2006 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis*, Tampa, FL, November 11–17. [pdf]

Murià-Vila, D., Taborda, R., and Zapata, A. (2004). Soil-structure interaction effects in two instrumented tall buildings. In Canadian Association for Earthquake Engineering, editor, *Proceedings of the 13th World Conference on Earthquake Engineering*, Vancouver, British Columbia, Canada. International Association for Earthquake Engineering. Paper No. 1911. [pdf]

Taborda, R. and Ordaz, M. (2003). Procedure to estimate the modal damping values of a system starting from transfer functions. In *Proceedings of the XIV Mexican National Conference on Earthquake Engineering*, León, Guanajuato, Mexico, November 19–22. [pdf]

Taborda, R., Murià-Vila, D., Pérez, R., and Macías, M. A. (2002). Soil-structure interaction effects of a building in Acapulco. In *Proceedings of the XIII Mexican National Conference on Structural Engineering*, Puebla, Puebla, Mexico, October 30 – November 2. [pdf]

Publications (continued)

Murià-Vila, D., Taborda, R., Macías, M. A., and A., E. J. (2002). Instrumentation of a tall building in the city of acapulco. In *Proceedings of the VIII Chilean Days on Seismology and Earthquake Engineering*, Valparaiso, Chile, April 24–26. [pdf]

Conference Posters:

Small, P., Maechling, P., Jordan, T., Ely, G., and Taborda, R. (2011). SCEC UCVM — Unified California velocity model. In *Proceedings and Abstracts of the 2011 SCEC Annual Meeting*, number B-129, Palm Springs, CA, September 11–14 [pdf]

Isbiliroglu, Y. D., Taborda, R., and Bielak, J. (2011). Interaction between earthquake ground motion and building models — A 3D parametric study. In *Proceedings and Abstracts of the 2011 SCEC Annual Meeting*, number B-035, Palm Springs, CA, September 11–14 [pdf]

Taborda, R. and Bielak, J. (2010c). Three dimensional nonlinear soil and site-city effects in earthquake simulations. In *Abstracts presented at 2010 Fall Meeting, AGU*, San Francisco, California, December 13–17. Abstract S51A-1923. [pdf]

Bielak, J., Karaoglu, H., and Taborda, R. (2010b). Memory-efficient displacement-based internal friction for wave propagation simulation. In *Abstracts presented at 2010 Fall Meeting, AGU*, San Francisco, California, December 13–17. Abstract S43B-2078. [pdf]

Taborda, R. and Bielak, J. (2010a). Full 3D nonlinear soil effects in large-scale ground motion simulations. In *Proceedings and Abstracts of the 2010 SCEC Annual Meeting*, Palm Springs, CA, September 11-15. [pdf]

Taborda, R. and Bielak, J. (2010b). Site-city effects in large-scale 3D earthquake simulations. In *Proceedings and Abstracts of the 2010 SCEC Annual Meeting*, Palm Springs, CA, September 11-15. [pdf]

Moczo, P., Kristek, J., Franek, P., Chaljub, E., Bard, P.-Y., Tsuno, S., Hollender, F., Iwan, W., Iwaki, A., Priolo, E., Klin, P., Aoi, S., Mariotti, C., Bielak, J., Taborda, R., Karaoglu, H., Etienne, V., and Virieux, J. (2010). Numerical modeling of earthquake ground motion in the mygdonian basin, greece: Verification of the 3D numerical methods. In *Abstracts of the 2010 SSA Annual Meeting*. [pdf]

Taborda, R., Karaoglu, H., Bielak, J., Urbanic, J., López, J., and Ramírez-Guzmán, L. (2009). Chino Hills — A highly computationally efficient 2 Hz validation exercise. *Eos Transcripts of the American Geophysical Union*, 90(52): Fall Meeting Supplement, Abstract S43A–1977. [pdf]

Ely, G. P., Jordan, T., Maechling, P., Olsen, K. B., Day, S. M., Minster, J. B., Graves, R., Ma, S., Beroza, G. C., Bielak, J., Taborda, R., Cui, Y., Urbanic, J., and Callagham, S. (2009). The Big Ten earthquake scenarios for southern california. *Eos Transcripts of the American Geophysical Union*, 90(52): Fall Meeting Supplement, Abstract S34A–03. [pdf]

Taborda, R. and Bielak, J. (2009). Three-dimensional modeling of earthquake ground motion including nonlinear wave propagation in soils. *Seismological Research Letters*, 80(2):320 SSA Annual Meeting. [pdf]

Publications (continued)

Bielak, J., Graves, R. W., Olsen, K. B., Taborda, R., Ramírez-Guzmán, L., Day, S. M., Ely, G. P., Roten, D., Jordan, T. H., Maechling, P. J., Urbanic, J., Cui, Y., and G., J. (2008). ShakeOut simulations — Verification. *Eos Transcripts of the American Geophysical Union*, 89(53): Fall Meeting Supplement, Abstract S33A–1921. [pdf]

Taborda, R., Ramírez-Guzmán, L., López, J., Urbanic, J., Bielak, J., and O'Hallaron, D. (2007b). ShakeOut and its effects in Los Angeles and Oxnard areas. *Eos Transcripts of the American Geophysical Union*, 88(52): Fall Meeting Supplement, Abstract IN21B–0477. [pdf]

Taborda, R., López, J., O'Hallaron, D., Tu, T., and Bielak, J. (2007a). A review of the current approach to CVM-Etrees. In *Proceedings and Abstracts of the 2007 SCEC Annual Meeting*, Palm Springs, CA, September 8-12. [pdf]

Taborda, R., Ramírez-Guzmán, L., Tu, T., López, J., Bielak, J., and O'Hallaron, D. (2006b). TeraShake simulations using Hercules: Analysis and comparison. In *Proceedings and Abstracts of the 2006 SCEC Annual Meeting*, Palm Springs, CA, September 10-13. [pdf]

Conference Presentations:

Taborda, R., Trocha, P., and Bielak, J. (2011). Influence of the built environment on the ground motion using 3d large-scale earthquake simulation. *Seismological Research Letters*, 82(2):289 SSA Annual Meeting.

Bielak, J., Chen, C.-K., Elgamal, A.-W., Fenves, G. L., Lu, J., Ma, K.-L., Petropoulos, G., and Taborda, R. (2009). Toward petascale simulation of urban earthquake impacts. In *Proceedings of the 10th US National Congress on Computational Mechanics*, Columbus, OH, July 16-19.

Ramírez-Guzmán, L., Contreras, M., Taborda, R., and Bielak, J. (2008). Ground motion in the valley of Mexico: Basin effects. In *Abstracts of the 2008 SSA Annual Meeting*, Santa Fe, NM, April 16–18.

Taborda, R., Ramírez-Guzmán, L., Tu, T., Kim, E. J., López, J., Bielak, J., Ghattas, O., and O'Hallaron, D. (2006a). Scaling up TeraShake: A 1-Hz case study. *Eos Transcripts of the American Geophysical Union*, 87(52): Fall Meeting Supplement, Abstract S51E–07.

Other Writings:

I maintain and write an opinion column about Colombian politics and related topics in a Web blog called *Opinión Personal* (http://www.loblancolonegro.com). This is the continuation of the publication *Lo Blango & Lo Negro*, an initiative for critical writing created while attending EAFIT University.

Invited Talks

Talks related to Ph.D. and postdoctoral research on earthquake simulations including nonlinear soil behavior and site-city effects are indicated with the symbol †. Talks with emphasis on high-performance computing, and verification and validation of simulation of earthquake systems are indicated with the symbol ‡.

‡ University of Washington and Carnegie Mellon University, Joint CMU/UW Data-Intensive eScience Seminar, "Earthquake simulations at scale", September, 2011.

† EAFIT University, Department of Civil and Environmental Engineering, "Earthquake simulations at scale and related complex engineering problems", July, 2011.

† Javeriana University, Department of Civil and Environmental Engineering, "Earthquake simulations at scale and related complex engineering problems", July, 2011.

† University of Illinois at Urbana-Champaign, Department of Civil and Environmental Engineering, "Earthquake simulations at scale and related complex engineering problems", May, 2011.

† University of Notre Dame, Department of Civil Engineering and Geological Sciences, "Earthquake simulations at scale and other shaking phenomena", February, 2011.

Professional and Mentoring Activities

Co-advisor, Honors Research program, Dean's Office of Undergraduate Studies, Carnegie Institute of Technology, Carnegie Mellon University. Advisee: Peter A. Trocha; Term: 2010–2011.

Science Advisor, Screenwriting Competition, School of Drama, College of Fine Arts, Carnegie Mellon University and the Public Understanding of Science and Technology (Film) Program of the Alfred P. Sloan Foundation. Advisee: Elizabeth Ellison; Term: 2010–2011.

Judge, Annual Graphics Competition Award, Younger Members Committee, Earthquake Engineering Research Institute (EERI), 2008–2010.

Participant, Community Modeling Environment group at the Southern California Earthquake Center (SCEC/CME).

Reviewer, Geophysical Journal International, 2011–present.

Member, American Geophysical Union.

Member, Seismological Society of America.

Service & Leadership Activities

At Carnegie Mellon University:

Member, Graduate Student Advisory Council, Civil and Environmental Engineering Department, 2006–2009.

At EAFIT University:

Representative, University Academic Council, 1999–2000.

Vice President, University Student Organization (OE), 1998.

Founder, Director and Editor in Chief, Lo Blanco & Lo Negro, 1998–2000.

Founder, President, and Representative for the Civil Engineering Students Committee (COINCI-OE), 1995–1998.

In the Community:

Member, Colombia en Pittsburgh, 2005–present.

Co-President, Colombia en Pittsburgh, 2007–2008.

Volunteer, Children's Hospital of Pittsburgh Care Mobile, Birmingham Free Clinic, Pittsburgh, 2006–2007.

Volunteer, Welcome Center for Immigrants and Internationals, Pittsburgh, 2006.

Participation in Research Grants and Projects

As a Co-Principal Investigator:

Enabling the SCEC Modeling Community to Conduct Physics-Based, Deterministic Broadband Earthquake Simulations using a High-Performance Portable Parallel Software. Sponsor: Southern California Earthquake Center. Amount: $50,000. Period: 02/01/2012–01/31/2013; PI: Jacobo Bielak (CMU). Status: Pending.

Response of Buildings in the Presence of Multiple, Simultaneous Soil-Structure Interaction Effects in Dense Urban Regions. Sponsor: Earthquake Hazard Program of the U.S. Geological Survey, External Research Support. Amount: $79,999. Period: 09/01/2011-8/31/2012. PI: Jacobo Bielak (CMU). Status: Pending.

CyberShake3.0: Physics-based Probabilistic Seismic Hazard Analysis. Sponsor: Department of Energy, Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program. Amount: 50 million CPU hours. Period: 01/01/2012-12/31/2012. PI: Thomas H. Jordan (USC). Co-PI: Jacobo Bielak (CMU), Kim Olsen (SDSU), Yifeng Cui (SDSC), Geoffrey Ely (ANL), Philip Maechling (USC). Status: Pending.

Participation in Research Grants and Projects (continued)

As a Participant (Equal Partner):

The following are research projects in which I have participated as an equal partner in the preparation of the proposal, and in planning and executing the proposed activities.

Implementation and Application of Inelastic Soil Models in Full 3D Earthquake Simulations. Sponsor: Earthquake Hazard Program of the U.S. Geological Survey, External Research Support. Award: G11AP20127. Amount: $84,959. Period: 04/01/2011-03/31/2012. PI: Jacobo Bielak (CMU). Status: Current.

Three-dimensional nonlinear earthquake ground motion simulation in the Salt Lake Basin using the Wasatch Front Community Velocity Model. Sponsor: Earthquake Hazard Program of the U.S. Geological Survey, External Research Support. Award: G10AP00077. Amount: $70,000. Period: 09/01/2010-08/31/2011. PI: Jacobo Bielak (CMU). Status: Completed.

Hybrid three-dimensional modeling of earthquake ground motion in basins, including nonlinear wave propagation in soils. Sponsor: Earthquake Hazard Program of the U.S. Geological Survey, External Research Support. Award: 08HQGR0018. Amount: $78,816. Period: 12/01/2007-11/30/2008. PI: Jacobo Bielak (CMU). Status: Completed.

As a Participant (Other):

The following is a research project in which I have had an active role in planning and executing the activities, and in which I had an auxiliary role in the preparation of the proposal.

Towards Petascale Simulation of Urban Earthquake Impacts. Sponsor: National Science Foundation, Office of CyberInfrastructure. Award: 0749227. Amount: $1,606,000. Period: 10/01/2007-09/30/2012. PI: Jacobo Bielak (CMU). Co-PIs: Gregory Fenves (UTAustin), Ahmed Elgamal (UCSD), David O'Hallaron (CMU), Kwan-Liu Ma (UCDavis). Status: Current.

Coursework in Graduate Education

Carnegie Mellon University (Ph.D.):

Finite Elements in Mechanics I
Fundamental Data Structures and Algorithms
Mathematical Techniques in Mechanical Engineering
Signals and Systems
Teaching Workshop
Java J2EE Programming

Coursework in Graduate Education (continued)

University of Southern California (M.Sc.):

Introduction to Programming Systems Design
Stability of Structures
Earthquake Engineering II
Mechanics of Solids I
Finite Element Analysis
Engineering Analytical Methods
Earthquake Engineering I
Numerical Analysis and Computation
Wave Propagation in Solids

National University of Mexico (M.Sc.):

Earthquake Engineering II
Masonry Structures Design
Earthquake Engineering I
Seismic Behavior and Design of Concrete Structures
Linear Algebra
Behavior of Concrete Elements
Advanced Structural Mechanics
Structural Dynamics I

Personal References

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Thomas H. Jordan
University Professor and W.M. Keck Foundation Chair in Geological Sciences
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David R. O'Hallaron
Professor, School of Computer Science and Dept. of Electrical and Computer Engineering
Research Scientist, Intel Labs Pittsburgh
Computer Science Department
Gates-Hillman Center, Suite 6107
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James H. Garrett, Jr.
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