

# Pablo Valdivia y Alvarado

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## Main research thrust

Understanding and tailoring the dynamic mechanical behavior of robotic structures plays an important role on locomotion, manipulation and sensing performance, and several useful lessons can be gained by understanding the physics behind the superior performance of biological creatures. My research goals are to develop dynamic models and new biomimetic mechanical structures that can improve the locomotion and sensing performance of mobile robots.

**Education**      **Massachusetts Institute of Technology**      Cambridge, MA  
*Doctor of Philosophy in Mechanical Engineering, December 2006.*  
Specialization: Machine Design, Controls and Robotics  
Thesis: “Design of Biomimetic Compliant Devices for Locomotion in Liquid Environments”  
Supervisor: Kamal Youcef-Toumi, Sc.D.  
Committee: Woodie Flowers, Michael Triantafyllou, and Julio Guerrero  
Project info: <http://web.mit.edu/pablov/www/research.html>  
Minor: Applied Mathematics.

**Massachusetts Institute of Technology**      Cambridge, MA  
*Master of Science in Mechanical Engineering, February 2001.*  
Specialization: Machine Design and Controls  
Thesis: “Design, Analysis and Control of an Autonomous Conveyance Module for Well Exploration”  
Supervisor: Samir Nayfeh, Ph.D.

**Massachusetts Institute of Technology**      Cambridge, MA  
*Bachelor of Science in Mechanical Engineering, June 1999.*  
Major: Controls  
Thesis: “Modeling and Identification for Control of a Holonomic Variable-Footprint Wheelchair”  
Supervisor: Haruhiko H. Asada, Ph.D.

**Lycée Franco-Bolivien Alcides D’Orbigny**      La Paz, Bolivia  
Graduated Valedictorian, class of 1994. French Baccalaureate with honor mention, series C (Scientific).

## Professional Experience

**Energid Technologies.**      Cambridge, MA  
January 2010 - August 2010. Principal Robotic Systems Engineer. Principal investigator and lead mechanical designer in the areas of Mechatronics, Robotics, and Biomechanical Engineering. Responsibilities include project management, hardware development, and support for business development in new technology sectors.  
February 2007 - December 2009. Senior Robotic Systems Engineer. Lead mechanical designer in the areas of Mechatronics, Robotics, and Biomechanical Engineering. Responsibilities included project management, hardware development, and business development.

**Alpine Pharmaceuticals Inc.**      Boston, MA  
August 2002 - June 2006. Product development consultant. Developed fluidic devices for hair care, electromechanical gardening tools, and infant nutrition products. Work includes modeling,

design and prototyping. Extensive use of polymer based 3D printing techniques. One patent granted (7,055,528), two patent applications pending.

**Schlumberger Cambridge Research Center** Cambridge, England

June - August 2000. Designed and built a rover type vehicle for downhole exploration. The prototype was used for experimental testing of friction losses and power consumption during downhole operation.

**Schlumberger Doll Research Center** Ridgefield, CT

June 1999 - January 2000. Developed a new autonomous propulsion module for downhole logging tools. Tasks included mechanical design, system modeling and implementation of control hardware and software. A working prototype and a simulated well for testing were built.

**MIT D'Arbellof Laboratory** Cambridge, MA

September 1998 - May 1999. Undergraduate research opportunity program (UROP). Work included modeling and system identification of model parameters for control of a Holonomic Omnidirectional wheelchair.

**Schlumberger Perforating and Testing** Houston, TX

June - August 1998: Modeled the dynamic behavior of well perforating guns during an accidental drop and presented the design of a safety mechanism to reduce any damages.

June - August 1997: Assisted in the development of new techniques for the manufacture of perforating devices (Shape charges) to increase penetration depths.

**MIT Ocean Engineering Towing Tank** Cambridge, MA

Fall 1996 - Fall 1998. Undergraduate research opportunity program (UROP). Work included machining, design and modification of robot parts for "Robopike" project.

## Teaching Experience

**MIT Mechanical Engineering Department** Cambridge, MA

Fall 2005-Fall 2007: Supervised two undergraduate thesis in Mechanical Engineering.

Fall 2006: Teaching Assistant for *Advanced System Dynamics and Controls* (2.151), 30 students.

Fall 2004, 2002, 2001, 2000: Teaching Assistant for *Elements of Mechanical Design* (2.72), taught weekly recitations and practice laboratory sessions. Prepared and graded quizzes and problem sets, 20 - 50 students.

Spring 2000: Teaching Assistant for *System Dynamics and Control* (2.004), taught weekly recitations and graded quizzes, 100 students.

## Publications Refereed Journal Articles:

**P. Valdivia y Alvarado**, and K. Youcef-Toumi, "On the Design and Control of Soft Biomimetic Robots", *Under review*, 2010.

B. Epps, **P. Valdivia y Alvarado**, K. Youcef-Toumi, and A. Techet, "Swimming Performance of a Biomimetic Compliant Fish-like Robot", *Experiments in Fluids*, **47**(6), 927-939, 2009.

**P. Valdivia y Alvarado**, and K. Youcef-Toumi, "Design of Machines with Compliant Bodies for Biomimetic Locomotion in Liquid Environments", *ASME Journal of Dynamics Systems Measurement and Control*, **128**, 3-13, March 2006.

## Refereed Conference Papers:

H. Hans, J. Miao, **P. Valdivia y Alvarado**, and M. Triantafyllou, "Chemical Composition and Physical Features of Harbor Seal (*Phoca Vitulina*) Vibrissae for Underwater Sensing Applications", *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, Phuket Island, Thailand, Dec. 2011.

**P. Valdivia y Alvarado**, "Hydrodynamic Performance of a Soft Body Under-actuated Batoid Robot", *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, Phuket Island, Thailand, Dec. 2011.

**P. Valdivia y Alvarado**, T. Taher, H. Kurniawati, G. Weymouth, R.R. Khan, J. Leighton, G. Papadopoulos, G. Barbastathis, and N. Patrikalakis, "A Coastal Distributed Autonomous Sensor Network", *MTS/IEEE OCEANS'11*, Kona, Hawaii, Sept. 2011.

**P. Valdivia y Alvarado**, S. Chin, W. Larson, A. Mazumdar, and K. Youcef-Toumi, "A Soft Body Under-actuated Approach to Multi Degree of Freedom Biomimetic Robots: A

stingray example”, IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BIOROB), Tokyo, Japan, Sept. 2010.

**P. Valdivia y Alvarado**, C.Y. Chang, and K. Hynynen, “Design of a Manipulator System for Hemorrhage Detection and Treatment using High Intensity Focused Ultrasound (HIFU)”, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp:4529-4534, 2009.

Y.J. Lim, T. Le, **P. Valdivia y Alvarado**, C.Y. Chang, and N. Tardella, “A Regional Anesthesia Training Simulation System”, Proceedings of Medicine Meets Virtual Reality (MMVR) 17, Long Beach, CA., Jan, 2009.

A. Mazumdar, **P. Valdivia y Alvarado**, and K. Youcef-Toumi, “Maneuverability of a Robotic Tuna with Compliant Body”, Proc. IEEE International conference on robotics and automation (ICRA), Pasadena, CA 2008.

Y.J. Lim, T. Le, **P. Valdivia y Alvarado**, N. Tardella, and K. Curley, Simulation-Based Military Regional Anesthesia Training System, 26th Army Science Conference, Orlando, FL, December, 2008.

Y.J. Lim, **P. Valdivia y Alvarado**, C.Y. Chang, and N. Tardella, MR Fluid Haptic System for Regional Anesthesia Training Simulation, Proceedings of Medicine Meets Virtual Reality (MMVR) 16, Long Beach, CA., Jan 29-Feb 01, 2008.

**P. Valdivia y Alvarado**, and K. Youcef-Toumi, “Performance of machines with flexible bodies designed for biomimetic locomotion in liquid environments”, Proc. IEEE International conference on robotics and automation (ICRA), Barcelona, Spain 2005.

**P. Valdivia y Alvarado**, and K. Youcef-Toumi, “Modeling and design methodology for an efficient underwater propulsion system”, Proc. IASTED International conference on Robotics and Applications, Salzburg, Austria 2003.

#### Invited Talks

- “Vehicles and Sensors for a Robust Coastal Distributed Autonomous Sensor Network”, Temasek Laboratories, Oct. 2011.
- “A Coastal Distributed Autonomous Sensor Network”, Project STARFISH: 6th Workshop on Autonomous Underwater Vehicles, National University of Singapore, Aug. 2011.
- “A Soft Body Under-actuated Approach to Multi Degree of Freedom Biomimetic Robots”, Keynote talk for 3rd International Conference on Underwater System Technology, USYS '10, Cyberjaya, Malaysia, Nov. 2010.
- American telemedicine association, 13th Annual international meeting, April 2008.
- Medicine meets virtual reality 16th Annual meeting, January 2008.
- A day of Locomotion, Radcliffe Gymnasium, Radcliffe Yard, October 16 2007.
- Robo-night at the MIT Museum, November 2005.
- Schlumberger Doll Research Technical Reviews 2005, 2006.
- Schlumberger SCR Technical Review 2002.

#### Patents

- Mechanical fish robot exploiting vibration modes for locomotion. US patent 7,865,268 B2.
- Bi-directional fixating/locking transvertebral body screw/intervertebral cage stand-alone constructs and posterior cervical and lumbar interarticulating joint stapling guns and devices for spinal fusion. US patent 7,972,363.
- Bi-directional fixating transversal body screws and posterior cervical and lumbar interarticulating joint calibrated stapling devices for spinal fusion. US patent 7,942,903.
- Applicator. US patent 7,055,528.
- Deicer U.S.S.N.: 60/886,863 (Provisional US patent application).
- Dispensing device U.S.S.N.: 60/886,867 (Provisional US patent application).
- Multifunction foldable laundry hamper U.S.S.N.: 60/886,878 (Provisional US patent application).
- Multifunction drying rack U.S.S.N.: 60/886,874 (Provisional US patent application).
- Citrus Harvester U.S.S.N.: 61/126,382 (Provisional US patent application).

## Funding

- Department of Defense, U.S. Army Medical Research and Materiel Command - \$779,915  
Principal Investigator, 11/2009 - 11/2011  
“Autonomous Airway Management”
- Department of Defence, U.S. Army Medical Research and Materiel Command- \$99,999  
Principal Investigator, 4/2010 - 11/2010  
“Actively Compliant Parallel End-Effector Mechanism for Medical Interventions”
- Department of Defense, U.S. Army Medical Research and Materiel Command - \$69,998  
Principal Investigator, 2/2009 - 8/2009  
“Autonomous Airway Management”
- Department of Defense, U.S. Army Medical Research and Materiel Command - \$849,929  
Principal Investigator, 8/2006 - 1/2009  
“Robotic High Intensity Focused Ultrasound (HIFU) Manipulator System for Critical Systems Transport (CSTAT)”
- U.S. Department of Agriculture - \$80,000  
Coauthor with PI James English (Energid Technologies), 5/2008 - 12/2009  
“Robotic Mass Removal of Citrus Fruits”

## Publicity

### Biomimetic Robotic Fish

- Emerging Technologies (MIT Technology Review) article 2005(+).
- Featured on MIT News, Technology Review, VOL 112, No 6. 2009.
- Featured on CNN.com/Technology, August 2009.
- Featured on Discovery Channel, Discovery News, 2009.
- Featured on CNET, 2009.
- Featured on Gizmodo, 2009.
- Featured on WIRED News, 2009.
- Featured on NATURE blogs, 2009.
- Featured on National Geographic Magazine, February 2010.

## Service Activities

- Technical reviewer for the Journal of Fluids and Structures.
- Technical reviewer for IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2011.
- Technical reviewer for IEEE International Conference on Robotics and Automation (ICRA) 2007.
- Technical reviewer for IEEE Conference on Decision and Control (CDC) 2007.
- Technical reviewer for the International Journal of Zhejiang University Science (JZUS) 2007.
- Technical reviewer for IASTED international conference on Robotics and Applications, Salzburg 2003.

## Awards

- French Foreign Affairs Ministry Scholarship to continue superior studies in France.  
(Awarded to one student out of the entire graduating class).
- Machine developed in “Design and Manufacturing I (2.007)” was exposed at the museum of science as part of the ROBOTICS exposition (summer 1998).

## Technical Skills

**CAD & Design Software:** SolidWorks, ProEngineer, 3Ds Max.

**Analysis, Simulation, and Publishing Software:** MATLAB, Mathematica, dSPACE, C, LATEX, HTML.

**Materials:** Modeling and experimental characterization of smart materials (Electro-active polymers, MR fluids, Piezo composites), polymers, and elastomers (polyurethane and silicone gels). Extensive use of Dynamical Mechanical Analyzers and Dynamics Signal Analyzers.

**Prototyping:** Proficient machining with lathes, mills, waterjets and other shop machines, vacuum molding and composite part fabrication, casting, polymer molding and 3D printing.

**Languages:** Fluent in English, Spanish, and French.

**Professional Affiliations**

American Society of Mechanical Engineers (ASME)  
Institute of Electrical and Electronic Engineers (IEEE)  
American Physical Society (APS)  
Sigma Xi, The Scientific Research Society