

Curriculum Vitae of **Claudio Semini, PhD**

August 2014

CURRENT POSITION

Head of the **Dynamic Legged Systems lab**
Department of Advanced Robotics
Istituto Italiano di Tecnologia (IIT)
<http://www.iit.it/en/advr-labs/dynamic-legged-systems.html>



WORK/HOME ADDRESS

Department of Advanced Robotics
Istituto Italiano di Tecnologia (IIT)
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Web: <http://www.semini.ch>

PERSONAL

Born on August 25th 1977 in Zurich, Switzerland
Swiss citizenship
married

EDUCATION

2007 - 2010
Istituto Italiano di Tecnologia (IIT) and University of Genoa, Italy
PhD degree in Robotics (University of Genoa, Italy)

1998 - 2005
Swiss Federal Institute of Technology (ETH), Zurich, Switzerland
MSc degree in Information Technology and Electrical Engineering
Specialization in Robotics

1990 - 1997
Kantonsschule Zug, High School, Zug, Switzerland
Typus B: New and ancient languages (Latin)

RESEARCH PROJECTS

03/2010 - present
HyQ Project (continuation from PhD thesis)
Dynamic motion implementation with HyQ robot, running, jumping and walking over stairs and rough terrain, robot design evolution towards rugged, power-autonomous outdoor version, hydraulic actuation control and design, design and control of arms.
Positions: Post Doc (2010-2012), Lab head (since August 2012)
Department of Advanced Robotics, Istituto Italiano di Tecnologia (IIT), Italy

01/2007 - 02/2010
PhD Thesis: HyQ – Design and Development of a Hydraulically Actuated Quadruped Robot
Development of a four-legged rough-terrain robot of the size of a large dog with hydraulic and electric actuators that is designed to perform highly dynamic tasks.
Supervisors: Prof. Darwin Caldwell, Dr. Nikos Tsagarakis
Dipartimento di Informatica Sistemistica e Telematica (DIST), University of Genoa, Italy and Department of Advanced Robotics, Italian Institute of Technology, Italy

10/2004 - 04/2005

Master's Thesis: Obstacle Avoidance for a Redundant Manipulator with Binary Tactile Sensors

Development of a sensor based obstacle avoidance system for a redundant robot manipulator with six degrees of freedom and a weight compensation mechanism.

Supervisors: Prof. Shigeo Hirose, Prof. Christofer Hierold
Hirose Robotics Lab, Tokyo Institute of Technology, Japan

04/2004 - 08/2004

SiROP project: Integrating Artificial Neurons into Hardware

Student Research Opportunities: Implementation of an artificial neural network into fast hardware. Evaluation of possibilities and programming an FPGA.

Supervisors: Prof. Rolf Pfeifer, Martin Krafft
Artificial Intelligence Laboratory, University Zurich, Switzerland

08/2003 - 10/2003

Semester project: Interfacing and Controlling an Overhead Crane Model

Design of a graphical interface and control software for an overhead crane model. Emphasis on active reduction of load swing using different control algorithms.

Supervisors: Prof. Elio Usai, Dr. Alessandro Pisano
Automatic Control Group, Università degli studi di Cagliari, Italy

04/2002 - 07/2002

Semester project: Wearable Fingermouse

Debugging and modification of existing hardware. Implementation of a morphological image processing algorithm for a DSP to robustly track the finger position.

Supervisors: Prof. Gerhard Tröster, Patrick de la Hamette
Wearable Computing Laboratory, ETH Zurich, Switzerland

**STUDENT
(Co-)SUPER-
VISION**

Tomoo Yoneda, Ritsumeikan Univ., PhD internship, 2014-2015

Satoshi Kitano, Tokyo Tech, PhD Internship, 2014

Marco Camurri, IIT, PhD Candidate, 2014-2017

Luca Castangia, IIT, PhD Candidate, 2014-2017

Carlos Mastalli, IIT, PhD Candidate, 2014-2017

Alexander Winkler, Karlsruhe Ins. of Tech., MSc thesis student, 2013

Francesco Rovida, Univ. Genova, MSc thesis student, 2013

Anis Meguenani, INSA Strasbourg, MSc thesis student, 2013

Bilal Ur Rehman, IIT, PhD Candidate, 2013-2016

Marco Frigerio, IIT, PhD Candidate, 2010-2013

Michele Focchi, IIT, PhD Candidate, 2010-2013

Thiago Boaventura, IIT, PhD Candidate, 2010-2013

Hamza Khan, IIT, PhD Candidate, 2012-2015

Victor Barasuol, UFSC (Brazil), PhD Internship, 2011-2012.

Asif Arain, Università' di Genova (Italy), Master Thesis Student, 2012.

Sam Zapolsky, George Washington University (USA), PhD Internship, 2012.

Morteza Azad, Australian National University (Australia), PhD Internship, 2012.

Kana Kotaka, Toyota Technological Institute (Japan), MSc Internship, 2011.

Thomas McEntee, Heriot-Watt University (UK), MSc Internship, 2010.

Thiago Boaventura, UFSC (Brazil), Master Thesis Student, 2009.

WORKSHOP ORGANISATION

Design and Control of High-Performance Hydraulic Robots: Recent Advances and Perspectives (ICRA 2013, main organizer)

New Applications of Hydraulic Actuation for Fast, Powerful, Efficient, Compact, and Compliant Robots (IROS 2013, co-organizer)

Hydraulic Robots with Torque Control for Inverse Dynamics and Active Compliance (ICRA 2014, main organizer)

REVIEW ACTIVITIES

IROS, ICRA, ICMA, ICM, Humanoids Conf., ASME Journal of Mechanisms and Robotics, ASME J. of Mechanical Design, IEEE Transactions on Mechatronics, IEEE Transactions on Robotics, IEEE Transactions on Industrial Electronics, Int. J. of Humanoid Robotics, J. of Bioinspiration & Biomimetics, J. of Robotics and Computer Integrated Manufacturing, J. of Autonomous Robots, Program Committee for ICMA 2011.

VISITING RESEARCHER

06/2010 - 07/2010

CLMC lab, University of Southern California, USA. Prof. Stefan Schaal

10/2004 - 04/2005

Hirose Robotics lab, Tokyo Tech, Japan. Prof. Shigeo Hirose

TOP NEWS COVERAGE

- **IEEE Spectrum blog**, "HyQ quadruped robot is back with even more tricks", March 2014
<http://spectrum.ieee.org/automaton/robotics/robotics-hardware/hyq-quadruped-robot-is-back-with-even-more-tricks>
- The **Gadget Show** of Channel 5 UK, February 2014.
<http://www.youtube.com/watch?v=w8HC-xf01l0>
- **Discovery Channel's** Daily Planet, January 2014 (link works only in Canada)
<http://watch.discovery.ca/#clip1062522>
- Article in the **newspaper of Coop Switzerland**, translated into German, Italian and French, September 2013
http://www.semimi.ch/wp-content/uploads/CoopZeitungGermanSept2013_HyQ.pdf
- **IEEE spectrum blog**, "HyQ Quadruped Robot Learns to Avoid Stumbles, Visits London", July 2013
<http://spectrum.ieee.org/automaton/robotics/robotics-hardware/hyq-quadruped-robot-step-reflex>
- **Italian National TV** RAI 3, Science Program "Pixel", 14 July 2012
<http://www.tg3.rai.it/dl/tg3/rubriche/PublishingBlock-79554b45-1e4c-41a8-a474-ad3e22ab750f.html>
- **Russian TV** featuring HyQ, July 2012
http://www.vesti.ru/only_video.html?vid=432869

- **IEEE Spectrum Blog**, "Italian Quadruped Robot goes for a Walk", 14 May 2012
<http://spectrum.ieee.org/automaton/robotics/robotics-hardware/italian-quadruped-robot-goes-for-a-walk>
- **Youtube video** "HyQ - IIT's Hydraulic Quadruped Robot - Balancing and First Outdoor Tests", 14 May 2012, with >90'000 views (as of Aug 2014)
www.youtube.com/watch?v=AnwetZpRtFE
- **Wired Italy Magazine**, 1 November 2011
<http://italianvalley.wired.it/news/2011/11/01/istituto-italiano-tecnologia-robot-15324.html>
- **IEEE Spectrum Blog**, "HyQ Quadruped Robot From Italy Can Trot, Kick", 28 Oct. 2011
<http://spectrum.ieee.org/automaton/robotics/industrial-robots/hyq-quadruped-robot>
- **Youtube video** "HyQ - IIT's Hydraulic Quadruped Robot - Introduction", 27 Sept. 2011, with >54'000 views (as of Aug 2014)
www.youtube.com/watch?v=wPxXwYGZmd8
- **Swiss National TV SF DRS**, Science Program "Einstein", 7 April 2011
www.youtube.com/watch?v=vgkxbBkq2dY

PUBLICATIONS (visit www.iit.it/hyq for an updated list)

S. Bazeille, V. Barasuol, M. Focchi, M. Frigerio, I. Havoutis, D. G. Caldwell, **C. Semini**, Quadruped Robot Trotting over Irregular Terrain Assisted by Stereo-Vision, *Journal of Intelligent Service Robotics*, Volume 7, Issue 2, pp 67-77, 2014.

A. Winkler, I. Havoutis, S. Bazeille, J. Ortiz, M. Focchi, R. Dillmann, D. G. Caldwell, **C. Semini**, "Path Planning with Force-Based Foothold Adaptation and Virtual Model Control for Torque Controlled Quadruped Robots," *IEEE International Conference on Robotics and Automation (ICRA)*, 2014.

E. Kostamo, M. Focchi, E. Guglielmino, J. Kostamo, **C. Semini**, J. Buchli, M. Pietola, D. G. Caldwell, "A Magnetorheologically Damped Compliant Foot for a Legged Robotic Application," *Journal of Mechanical Design*, Vol. 136, 2014.

C. Semini, V. Barasuol, T. Boaventura, M. Frigerio, J. Buchli, "Is Active Impedance the Key to a Breakthrough for Legged Robots?" *International Symposium of Robotics Research (ISRR)*, 2013.

T. Boaventura, G.A. Medrano-Cerda, **C. Semini**, J. Buchli, D. G. Caldwell, "Stability and Performance of the Compliance Controller of the Quadruped Robot HyQ," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2013.

I. Havoutis, J. Ortiz, S. Bazeille, V. Barasuol, **C. Semini**, D. G. Caldwell, "Onboard Perception-Based Trotting and Crawling with the Hydraulic Quadruped Robot (HyQ)," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2013.

B. Ugurlu, I. Havoutis, **C. Semini**, D. G. Caldwell, "Dynamic Trot-Walking with the Hydraulic Quadruped Robot - HyQ: Analytical Trajectory Generation and Active Compliance Control," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2013.

V. Barasuol, J. Buchli, **C. Semini**, M. Frigerio, E. R. De Pieri, D. G. Caldwell, "A Reactive Controller Framework for Quadrupedal Locomotion on Challenging Terrain," *ICRA* 2013.

- M Focchi, V. Barasuol, I. Havoutis, J. Buchli, **C. Semini**, D. G. Caldwell, "Local Reflex Generation for Obstacle Negotiation in Quadrupedal Locomotion", Int. Conf. on Climbing and Walking Robots (CLAWAR), 2013.
- H. Khan, **C. Semini**, V. Barasuol, D. G. Caldwell, "Actuator sizing for highly-dynamic quadruped robots based on squat jumps and running trots", Int. Conf. on Climbing and Walking Robots (CLAWAR), 2013.
- S. Zapolsky, E. Drumwright, I. Havoutis, J. Buchli, **C. Semini**, "Inverse Dynamics for a Quadruped Robot Locomoting Along Slippery Surfaces", Int. Conf. on Climbing and Walking Robots (CLAWAR), 2013.
- S. Bazeille, V. Barasuol, M. Focchi, I. Havoutis, M. Frigerio, J. Buchli, **C. Semini**, D. G. Caldwell, "Vision Enhanced Reactive Locomotion Control for Trotting on Rough Terrain", IEEE International Conference on Technologies for Practical Robot Applications (TePRA), 2013.
- I. Havoutis, **C. Semini**, J. Buchli, D. G. Caldwell, "Quadrupedal trotting with active compliance," Int'l Conf. of Mechatronics, 2013.
- T. Boaventura, M. Focchi, M. Frigerio, J. Buchli, **C. Semini**, G. A. Medrano-Cerda, D. G. Caldwell, "On the role of load motion compensation in high-performance force control", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2012.
- C. Semini**, H. Khan, M. Frigerio, T. Boaventura, M. Focchi, J. Buchli and D. G. Caldwell, "Design and Scaling of Versatile Quadruped Robots", Int. Conf. on Climbing and Walking Robots (CLAWAR), 2012.
- T. Boaventura, **C. Semini**, J. Buchli, M. Frigerio, M. Focchi, D. G. Caldwell, "Dynamic Torque Control of a Hydraulic Quadruped Robot", Proceedings IEEE International Conference on Robotics and Automation (ICRA), 2012.
- M. Focchi, T. Boaventura, **C. Semini**, M. Frigerio, J. Buchli, D. G. Caldwell, "Torque-control Based Compliant Actuation of a Quadruped Robot", Proceedings of the 12th IEEE International Workshop on Advanced Motion Control (AMC), 2012.
- T. Boaventura, **C. Semini**, J. Buchli, D. G. Caldwell, "Actively-compliant leg for dynamic locomotion", Proceedings 5th International Symposium in Adaptive Motion of Animals and Machines (AMAM), 2011.
- C. Semini**, J. Buchli, M. Frigerio, T. Boaventura, M. Focchi, E. Guglielmino, F. Cannella, N. G. Tsagarakis and D. G. Caldwell, "HyQ - A Dynamic Locomotion Research Platform," Intl. Workshop on Bio-Inspired Robots, 2011.
- C. Semini**, N. Tsagarakis, E. Guglielmino, M. Focchi, F. Cannella, D. G. Caldwell, "Design of HyQ – a Hydraulically and Electrically Actuated Quadruped Robot," Journal of Systems and Control Engineering, vol. 225, no. 6, pp. 831–849, 2011.
- H. Kogler, R. Scheidl, M. Ehrentraut, E. Guglielmino, **C. Semini**, D. G. Caldwell, "A compact hydraulic switching converter for robotic applications," FPMC 2010.
- E. Guglielmino, F. Cannella, **C. Semini**, D. G. Caldwell, N. E. Nava Rodríguez, G. Vidal, "A Vibration Study of a hydraulically-actuated legged machine," IMECE 2010.

- C. Semini**, N. G. Tsagarakis, E. Guglielmino, D. G. Caldwell, "Design and Experimental Evaluation of the Hydraulically Actuated Prototype Leg of the HyQ Robot," IEEE/RSJ Int. Conf. on Intelligent RObots and Systems (IROS), 2010.
- M. Focchi, E. Guglielmino, **C. Semini**, A. Parmiggiani, N. G. Tsagarakis, B. Vanderborght and D. G. Caldwell, "Water/Air Performance Analysis of a Fluidic Muscle," IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2010.
- Y. S. Yang, E. Guglielmino, **C. Semini**, J. Dai and D. G. Caldwell, "A 3-Way Valve-Controlled Spring Assisted Rotary Actuator," IEEE/RSJ Int. Conf. on Intelligent RObots and Systems (IROS), 2010.
- E. Guglielmino, **C. Semini**, H. Kogler, R. Scheidl and D. G. Caldwell, "Power Hydraulics - Switched Mode Control of Hydraulic Actuation," IEEE/RSJ Int. Conf. on Intelligent RObots and Systems (IROS), 2010.
- M. Focchi, E. Guglielmino, **C. Semini**, T. B. Cunha, Y. S. Yang, D. G. Caldwell, "Control of a Hydraulically-Actuated Quadruped Robot Leg," IEEE Int. Conf. on Robotics and Automation (ICRA), 2010.
- T. B. Cunha, **C. Semini**, E. Guglielmino, V. J. De Negri, Y. S. Yang, D. G. Caldwell, "Gain Scheduling Control for the Hydraulic Actuation of the HyQ Robot Leg," Int. Conf. of Mechanical Engineering (COBEM), 2009.
- E. Guglielmino, **C. Semini**, Y. S. Yang, D. G. Caldwell, H. Kogler, R. Scheidl, "Energy Efficient Fluid Power in Autonomous Legged Robotics," ASME Dynamic Systems and Control Conference (DSCC), 2009.
- Y. S. Yang, **C. Semini**, N. G. Tsagarakis, E. Guglielmino, D. G. Caldwell, "Leg Mechanisms for Hydraulically Actuated Robots," IEEE/RSJ Int. Conf. on Intelligent RObots and Systems (IROS), pp. 4669-4675, 2009.
- Y. S. Yang, **C. Semini**, E. Guglielmino, N. G. Tsagarakis, D. G. Caldwell, "Water vs. Oil Hydraulic Actuation for a Robot Leg," IEEE Int. Conf. on Mechatronics and Automation (ICMA), pp. 1940-1946, 2009.
- B. Vanderborght, N. G. Tsagarakis, **C. Semini**, R. Van Ham, D. G. Caldwell, "MACCEPA 2.0: Adjustable Compliant Actuator with Stiffening Characteristic for Energy Efficient Hopping," IEEE Int. Conf. on Robotics and Automation (ICRA), pp. 544-549, 2009.
- Y. S. Yang, **C. Semini**, N. G. Tsagarakis, D. G. Caldwell, Y. Zhu, "Water hydraulics - A novel design of spool-type valves for enhanced dynamic performance," IEEE/ASME Int. Conf. on Advanced Intelligent Mechatronics (AIM), pp. 1308-1314, 2008.
- C. Semini**, N. G. Tsagarakis, B. Vanderborght, Y. S. Yang and D. G. Caldwell, "HyQ - Hydraulically Actuated Quadruped Robot: Hopping Leg Prototype," IEEE/RAS Int. Conf. on Biomedical Robotics and Biomechatronics (BioRob), pp.593-599, 2008.
- S. Hirose, M. Onishi, A. Kawakami, **C. Semini**, "Float Arm VI: Wire-Driven Weight Compensation Mechanism with Single Pulleys", in Japanese, 2005.

PATENTS

- E. Guglielmino, Y. Yang, G. Pane, **C. Semini**, D. G. Caldwell, "Servovalvola rotativa, particolarmente di tipo idraulico", in Italian, 2009.

INDUSTRY EXPERIENCE

09/2006 - 12/2006

Freelancer for HiBot Corporation, Tokyo, Japan

Integration and Debugging of a commercial CANopen communication interface in C language on a Renesas Microcontroller.

12/2005 - 09/2006

Researcher at Toshiba's Research & Development Center, Kawasaki, Japan

Implementation of force control for a robot arm: Evaluation and comparison of force/torque sensor systems; Member of the *Home Life Support Robot* group.

10/2002 - 02/2003

Internship: Whirlpool Europe, Cassinetta, Italy

The 6th sense Project: Simulation and experiments to develop an intelligent, virtual sensor system to improve electric ovens.

07/1998 - 10/1998

Internship: Mentec Ltd, Dublin, Ireland

Engineering and maintenance of computer boards for video conference applications and for stock exchange data centers.

11/1997 - 02/1998

Internship: Enecolo AG, Mönchaltorf, Switzerland

Engineering and realization of photovoltaic power plants.

SCHOLARSHIP

Swiss Japanese Chamber of Commerce (SJCC): Financial support during my Japanese language training from 07/2005 until 11/2005 and work period at Toshiba.

SKILLS

Software: C/C++, ProEngineer, Creo, Matlab, Pascal, Oberon, Renesas HEW, LATEX, git

Languages: German (mother tongue), English (fluent, Cambridge Advanced Certificate), Italian (fluent, CILS B2), French (high school level), Japanese (intermediate, JLPT-2)

MISCELLANEOUS

Summer 1999 - Summer 2002

Swiss Federal Institute of Technology, Zurich, Switzerland

Board member of the Local Committee Zurich of the Electrical Engineering Students' European Association (EESTEC) - Organization and Participation in Exchanges

Winter 97/98 - Summer 1998

1.5 kWp Photovoltaic Power Plant, Zug, Switzerland

Engineering and construction of a 1.5 kW_{peak} PV power plant on my parents' house

HOBBIES

Traveling, foreign languages/cultures, squash, mountain biking, scuba diving, skydiving

