

Andrea Censi

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EMPLOYMENT

	ETH Zürich – Zürich, Switzerland Deputy Director, Chair of Dynamic Systems and Control	02/2018 –
	ZüperMind – Zürich, Switzerland Founder	06/2019 –
	Duckietown Foundation President	06/2017 –
	Aptiv Autonomous Mobility – Boston, MA, USA Director of Research	03/2018 – 06/2019
	ETH Zürich – Zürich, Switzerland Senior researcher (<i>Oberassistent</i>) Institute for Dynamic Systems and Control, Department of Mechanical and Process Engineering	04/2017 – 01/2018
	nuTonomy, inc – Boston, MA, USA System Architect	09/2016 – 03/2018
	Massachusetts Institute of Technology , Cambridge, MA, USA. Research Scientist, Principal Investigator Laboratory for Information and Decision Systems	10/2013 – 04/2017

I have also held visiting positions. In 2012-13 I was Visiting Scholar at the AI Lab in D. Scaramuzza's group. In 2005 I was a visiting student at the Tokyo Institute of Technology, in Hirose lab.

EDUCATION

	California Institute of Technology , Pasadena, CA, USA. Ph.D. in Control & Dynamical Systems Thesis: <i>Bootstrapping Vehicles: a Formal Approach to Unsupervised Learning of Robotic Sensorimotor Cascades Based on Invariance</i> [16] Advisor: Richard M. Murray	9/2007 – 6/2012
	Università di Roma "La Sapienza" , Rome, Italy. <i>Laurea magistrale</i> (M.Sc.) in Control Engineering & Robotics, <i>cum laude</i> Thesis: <i>Robot Motion Planning with Uncertainty</i> [49] Advisors: G. Oriolo, A. De Luca <i>Laurea</i> (B.Sc.) in Automation & Control Engineering, <i>cum laude</i> Thesis: <i>Scan Matching in the Hough Domain</i> [56] (advisor: D. Nardi)	5/2005 – 5/2007 9/2001 – 5/2005

GRANTS AND AWARDS

- I have been the recipient as PI or co-PI of NSF, DARPA, and AFRL awards.
- Best conference paper finalist [40] at ICRA 2011. Best student paper finalist [36] at ICRA 2012.

ACADEMIC AND PROFESSIONAL SERVICE

- Reviewer/PC member for conferences/journals in robotics (T-RO, IJRR, ICRA, IROS, RSS) and control (TAC, TSP, Automatica, CDC, ACC). Associate Editor for ICRA and T-RO.
- National Science Foundation Panelist (2015)
- I have served as technical expert for the EU commission and UNECE.
- ICRA 2016 Publicity Chair. ICRA 2015 Trailer organizer and director.
- Co-organizer of The AI Driving Olympics at ICRA 2019, NeurIPS 2018, NeurIPS 2019.

I have co-organized many workshops. An incomplete list:









- RSS 2018 workshop on minimality / The Robot Design Game (with A. Nilles, D. Shell, J. O’Kane)
- Co-organizer with Soatto (UCLA), Tsiotras (GATECH) of ICRA 2016 workshop on “Task-driven representations”.
- Co-organizer with Scaramuzza (UZH) of ICRA 2015 workshop on “Innovative Sensing for Robotics”.
- Co-organizer with Boots (GATECH) of ICRA 2015 workshop on “Advances in Sensorimotor Learning”.
- Co-organizer with Frazzoli, Leonard of RSS 2015 workshop on “The Big Questions in Robotics”.

SELECTED PUBLICATIONS





















Legend:  link to pdf;  link to slides;  link to website with source code and datasets.

Preprints / working papers




(any feedback on preprints is much appreciated)

- [1] A. Censi, S. Bolognani, J. G. Zilly, S. S. Mousavi, and E. Frazzoli. “Today Me, Tomorrow Thee: Efficient Resource Allocation in Competitive Settings using Karma Games”. In: *CoRR abs/1907.09198* (2019)  .
- [2] G. Zardini, N. Lanzetti, M. Salazar, A. Censi, E. Frazzoli, and M. Pavone. “Towards a Co-Design Framework for Future Mobility Systems”. In: *CoRR abs/1910.07714* (2019)  .
- [3] G. Gallego et al. “Event-based Vision: A Survey”. In: *CoRR abs/1904.08405* (2019)  .
- [4] A. Censi. “A Mathematical Theory of Co-Design”. In: *CoRR abs/1512.08055* (2015)  .

Journal Papers / book chapters

- [5] J. G. Zilly et al. “The AI Driving Olympics at NeurIPS 2018”. In: *CoRR abs/1903.02503* (2019)  .
- [6] A. Censi. “Uncertainty in Monotone Co-Design Problems”. In: *IEEE Robotics and Automation Letters* (Feb. 2017)  .
- [7] A. Censi. “A Class of Co-Design Problems With Cyclic Constraints and Their Solution”. In: *IEEE Robotics and Automation Letters* 2.1 (Jan. 2016). Superseded by preprint “A Mathematical Theory of Co-Design”, pp. 96–103. ISSN: 2377-3766 DOI:10.1109/LRA.2016.2535127.
- [8] A. Censi and R. M. Murray. “Bootstrapping bilinear models of Simple Vehicles”. In: *International Journal of Robotics Research* 34 (July 2015), pp. 1087–1113 DOI:10.1177/0278364914557708   .
- [9] S. B. Fuller, M. Karpelson, A. Censi, K. Y. Ma, and R. J. Wood. “Controlling free flight of a robotic fly using an onboard vision sensor inspired by insect ocelli”. In: *Journal of the Royal Society Interface* 97 (Aug. 2014) .
- [10] L. Carlone and A. Censi. “From Angular Manifolds to the Integer Lattice: Guaranteed Orientation Estimation with Application to Pose Graph Optimization”. In: *IEEE Transactions on Robotics* 30.4 (Apr. 2014) DOI:10.1109/TRO.2013.2291626   .
- [11] A. Censi*, A. D. Straw*, R. W. Sayaman, R. M. Murray, and M. H. Dickinson. “Discriminating external and internal causes for saccade initiation in freely flying *Drosophila*”. In: *PLOS Computational Biology* 9.2 (Feb. 2013) DOI:10.1371/journal.pcbi.1002891   .
- [12] A. Censi and D. Scaramuzza. “Calibration by correlation using metric embedding from non-metric similarities”. In: *IEEE Transactions on Pattern Analysis and Machine Intelligence* 35 (10 Oct. 2013), pp. 2357–2370 DOI:10.1109/TPAMI.2013.34  .
- [13] A. Censi, A. Franchi, L. Marchionni, and G. Oriolo. “Simultaneous calibration of odometry and sensor parameters for mobile robots”. In: *IEEE Transactions on Robotics* 29.2 (Apr. 2013), pp. 475–492 DOI:10.1109/TRO.2012.2226380  .
- [14] D. Calisi, A. Censi, L. Iocchi, and D. Nardi. “Design choices for modular and flexible robotic software development: the OpenRDK viewpoint”. In: *Journal of Software Engineering for Robotics* 1 (3 Mar. 2012) .
- [15] A. Censi. “Kalman filtering with intermittent observations: convergence for semi-Markov chains and an intrinsic performance measure”. In: *IEEE Transactions on Automatic Control* (Feb. 2011). ISSN: 0018-9286 DOI:10.1109/TAC.2010.2097350 .

Dissertation

- [16] A. Censi. *Bootstrapping Vehicles: A Formal Approach to Unsupervised Sensorimotor Learning Based on Invariance*. Tech. rep. California Institute of Technology, 2012   .

Conference Papers

- [17] A. Zanardi, A. Aumiller, J. G. Zilly, A. Censi, and E. Frazzoli. “Cross-Modal Learning Filters for RGB-Neuromorphic Wormhole Learning”. In: *Robotics: Science and Systems XV, University of Freiburg, Freiburg im Breisgau, Germany, June 22-26, 2019*. 2019 DOI:10.15607/RSS.2019.XV.045  .
- [18] A. Censi, K. Slutsky, T. Wongpiromsarn, D. S. Yershov, S. Pendleton, J. G. M. Fu, and E. Frazzoli. “Liability, Ethics, and Culture-Aware Behavior Specification using Rulebooks”. In: *International Conference on Robotics and Automation, ICRA 2019, Montreal, QC, Canada, May 20-24, 2019*. 2019, pp. 8536–8542 DOI:10.1109/ICRA.2019.8794364  .
- [19] A. Zanardi, J. G. Zilly, A. Aumiller, A. Censi, and E. Frazzoli. “Wormhole Learning”. In: *International Conference on Robotics and Automation, ICRA 2019, Montreal, QC, Canada, May 20-24, 2019*. 2019, pp. 7899–7905 DOI:10.1109/ICRA.2019.8794336  .
- [20] Y. Nager, A. Censi, and E. Frazzoli. “What lies in the shadows? Safe and computation-aware motion planning for autonomous vehicles using intent-aware dynamic shadow regions”. In: *International Conference on Robotics and Automation, Montreal, QC, Canada, May 20-24, 2019*. 2019, pp. 5800–5806 DOI:10.1109/ICRA.2019.8793557  .
- [21] L. Paull et al. “Duckietown: an Open and Inexpensive and Flexible Platform for Autonomy Education and Research”. In: *IEEE International Conference on Robotics and Automation (ICRA)*. Singapore, May 2017  .
- [22] J. Tani, L. Paull, M. Zuber, D. Rus, J. How, J. Leonard, and A. Censi. “Duckietown: an Innovative Way to Teach Autonomy”. In: *EduRobotics 2016*. Athens, Greece, Dec. 2016  .
- [23] A. Censi. “Monotone Co-Design Problems; or, everything is the same”. In: *Proceedings of the American Control Conference (ACC)*. Superseded by preprint “A Mathematical Theory of Co-Design”. 2016 DOI:10.1109/ACC.2016.7525085.
- [24] E. Mueller, A. Censi, and E. Frazzoli. “Efficient high speed signal estimation with neuromorphic vision sensors”. In: *International Conference on Event-based Control, Communication, and Signal Processing (EBCSP)*. June 2015, pp. 1–8 DOI:10.1109/EBCSP.2015.7300672.
- [25] E. Mueller, A. Censi, and E. Frazzoli. “Low-latency heading feedback control with neuromorphic vision sensors using efficient approximated incremental inference”. In: *IEEE Conference on Decision and Control (CDC)*. Dec. 2015, pp. 992–999 DOI:10.1109/CDC.2015.7402002.
- [26] P. Singh, S. Z. Yong, J. Gregoire, A. Censi, and E. Frazzoli. “Stabilization of linear continuous-time systems using neuromorphic vision sensors”. In: *IEEE Conference on Decision and Control (CDC)*. Dec. 2016, pp. 3030–3036 DOI:10.1109/CDC.2016.7798722.
- [27] A. Censi. “Efficient Neuromorphic Optomotor Heading Regulation”. In: *American Control Conference (ACC)*. Chicago, IL, July 2015 DOI:10.1109/ACC.2015.7171931.
- [28] A. Censi, E. Mueller, E. Frazzoli, and S. Soatto. “A Power-Performance Approach to Comparing Sensor Families, with application to comparing neuromorphic to traditional vision sensors”. In: *IEEE International Conference on Robotics and Automation (ICRA)*. May 2015.
- [29] L. Carlone, A. Censi, and F. Dellaert. “Coherent Measurements Selection via l_1 Relaxation: an Approach to Robust Estimation over Graphs”. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Oct. 2014.
- [30] A. Censi and D. Scaramuzza. “Low-latency Event-Based Visual Odometry”. In: *IEEE International Conference on Robotics and Automation (ICRA)*. May 2014   .
- [31] A. Censi, J. Strubel, C. Brandli, T. Delbruck, and D. Scaramuzza. “Low-latency localization by Active LED Markers tracking using a Dynamic Vision Sensor”. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Tokyo, Japan, Nov. 2013, pp. 891–898 DOI:10.1109/IROS.2013.6696456   .
- [32] A. Nilsson and A. Censi. “Accurate recursive learning of uncertain diffeomorphism dynamics”. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Tokyo, Japan, Nov. 2013 DOI:10.1109/IROS.2013.6696504  .
- [33] A. Censi, A. Nilsson, and R. M. Murray. “Motion planning in observations space with learned diffeomorphism models.” In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Karlsruhe, Germany, May 2013, pp. 2860–2867 DOI:10.1109/ICRA.2013.6630973  .
- [34] P. Puente and A. Censi. “Dense Map Inference with User-Defined Priors: From Priorlets to Scan Eigenvariations”. In: *Spatial Cognition VIII*. Ed. by C. Stachniss, K. Schill, and D. Uttal. Vol. 7463. Lecture Notes in Computer Science. Springer Berlin Heidelberg, Aug. 2012, pp. 94–113. ISBN: 978-3-642-32731-5 DOI:10.1007/978-3-642-32732-2_6  .
- [35] A. Censi and R. M. Murray. “Learning diffeomorphism models of robotic sensorimotor cascades”. In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Saint Paul, MN, May 2012 DOI:10.1109/ICRA.2012.6225318  .
- [36] A. Censi, M. Håkansson, and R. M. Murray. “Fault detection and isolation from uninterpreted data in robotic sensorimotor cascades”. In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. **Best student paper finalist**. May 2012 DOI:10.1109/ICRA.2012.6225311  .
- [37] D. Scaramuzza, A. Censi, and K. Daniilidis. “Exploiting motion priors in visual odometry for vehicle-mounted cameras with non-holonomic constraints”. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. San Francisco, CA, Sept. 2011 DOI:10.1109/IROS.2011.6095123 .
- [38] A. Censi and R. M. Murray. “Uncertain semantics, representation nuisances, and necessary invariance properties of bootstrapping agents”. In: *Joint IEEE International Conference on Development and Learning and Epigenetic Robotics*. Frankfurt, Germany, Aug. 2011 DOI:10.1109/DEVLRN.2011.6037313  .
- [39] A. Censi and R. M. Murray. “Bootstrapping sensorimotor cascades: a group-theoretic perspective”. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. San Francisco, CA, Sept. 2011 DOI:10.1109/IROS.2011.6095151  .
- [40] A. Censi and R. M. Murray. “Bootstrapping bilinear models of robotic sensorimotor cascades”. In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. **Best conference paper finalist**. Shanghai, China, May 2011 DOI:10.1109/ICRA.2011.5979844  .

- [41] S. Han, A. Censi, A. D. Straw, and R. M. Murray. "A bio-plausible design for visual pose stabilization". In: *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Taipei, Taiwan, Oct. 2010, pp. 5679–5686 DOI:10.1109/IROS.2010.5652857  .
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- [43] A. Censi. "On the performance of Kalman filtering with intermittent observations: a geometric approach with fractals". In: *Proceedings of the American Control Conference (ACC)*. St. Louis, Missouri, June 2009 DOI:10.1109/ACC.2009.5159869   .
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- [48] D. Calisi, A. Censi, L. Iocchi, and D. Nardi. "OpenRDK: A Modular Framework for Robotic Software Development". In: *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Nice, France, Sept. 2008 DOI:10.1109/IROS.2008.4651213   .
- [49] A. Censi, D. Calisi, A. D. Luca, and G. Oriolo. "A Bayesian framework for optimal motion planning with uncertainty". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Pasadena, CA, May 2008 DOI:10.1109/ROBOT.2008.4543469   .
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- [51] A. Censi and G. D. Tipaldi. "Lazy Localization using the Frozen-Time Smoother". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Pasadena, CA, May 2008 DOI:10.1109/ROBOT.2008.4543631   .
- [52] A. Censi, L. Marchionni, and G. Oriolo. "Simultaneous maximum-likelihood calibration of robot and sensor parameters". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Pasadena, CA, May 2008 DOI:10.1109/ROBOT.2008.4543516   .
- [53] A. Censi. "An accurate closed-form estimate of ICP's covariance". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Rome, Italy, Apr. 2007, pp. 3167–3172 DOI:10.1109/ROBOT.2007.363961   .
- [54] A. Censi. "On achievable accuracy for range-finder localization". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Rome, Italy, Apr. 2007, pp. 4170–4175 DOI:10.1109/ROBOT.2007.364120   .
- [55] A. Censi. "Scan matching in a probabilistic framework". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Orlando, Florida, May 2006, pp. 2291–2296 DOI:10.1109/ROBOT.2006.1642044   .
- [56] A. Censi, L. Iocchi, and G. Grisetti. "Scan matching in the Hough domain". In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*. Barcelona, Spain, 2005, pp. 2739–2744 DOI:10.1109/ROBOT.2005.1570528   .