

Maryam Kamgarpour

Assistant Professor, ETH Zürich, Department of Information Technology & Electrical Engineering
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Research Focus

Theory: multi-agent decision making, game theory, stochastic optimization and control

Applications: electrical power system, robotics, air traffic system

Education

University of California, Berkeley, USA, Ph.D. in Mechanical Engineering Dec 2011

Advisor: Prof. Claire J. Tomlin, Electrical Engineering & Computer Sciences

Thesis title: Optimal Control of Hybrid Systems in Air Traffic Applications

University of Waterloo, Canada, B.A.S. in Systems Design Engineering May 2005

Professional Experience

Automatic Control Laboratory, ETH Zürich, Assistant professor Apr 2016-current

Professorship supported by the European Research Council (ERC) Starting Grant

Automatic Control Laboratory, ETH Zürich, Postdoctoral Fellow May 2012-Mar 2016

NASA Ames Research Center, Moffett Field, CA, USA May-Aug 2009

Internship in the Aviation Systems Division

Analyzed and synthesized fuel efficient aircraft arrival procedures

Applied Mathematics Department, University of Waterloo, Canada May-Aug 2004

Internship in the Control and Dynamical Systems Group

Designed a controller for an inverted pendulum under uncertain communication delay

MDS Sciex, Toronto, Canada Jan-Jul 2003

Internship in the Software Development Department

Developed spectral arithmetic software for a mass spectrometer

Sunnybrook Hospital & Women's College, Toronto, Canada May-Aug 2001

Internship in the Research Department

Designed an image processing software for a high frequency ultrasound machine

Proposals & Research Grants

Swiss National Science Foundation, Project Fund, Awarded 441,478 CHF 2017-2020

Topic: *Stochastic Control for Real-time Navigation Aid in Emergency Building Evacuation*

European Research Council, ERC Starting Grant, Awarded 1,346,438 Euros 2016-2020

Topic: *Control of Large-scale Uncertain systems for Renewable Energy Integration*

Swiss Nano-Tera Initiative, Multi-partner Project, Awarded 3,242,504 CHF 2013-2017

Co-authored a proposal: *Thermal Loads for Ancillary Services*

Natural Sciences & Engineering Research Council of Canada 2008

Wrote a proposal for own's Ph.D. research project, awarded \$63,000 CAD

Natural Sciences & Engineering Research Council of Canada 2006

Wrote a proposal for own's Master's research project, awarded \$17,500 CAD

Awards

European Research Council Starting Grant (1,346,438 Euros)	2015
Top 20 ETH Zürich Inventions of the Year	2013
NASA Aeronautics High Potential Individual Award	2010
NASA Aeronautics Technical Excellence in Publications Award	2010
Alexander Graham Bell Canada Graduate Scholarship, NSERC (\$63,000)	2008
M.S. Scholarship, Natural Sciences & Engineering Research Council of Canada (\$17,500)	2006
Block Grant Fellowship, Mechanical Engineering, UC Berkeley, USA (\$26,000)	2005
Ontario Graduate Scholarship, Canada (\$15,000, declined)	2005
Undergraduate Research Award, Natural Sciences & Engineering Research Council of Canada	2004
René Descartes Mathematics Scholarship, University of Waterloo, Canada (\$18,000, declined)	2000
Engineering Entrance Scholarship, University of Waterloo, Canada (\$3,000)	2000
Canadian Open Mathematics Contest, 12th in Canada, 1st in British Columbia	2000
Excellence in Community Book Award, North Vancouver, BC, Canada	2000

Teaching Experience

Game Theory with Engineering Applications, Co-lecturer Information Technology & Electrical Engineering Department, ETH Zürich Developing lesson plans on convex games and auctions based on own's research	Spring 2017
Linear System Theory, Lecturer and course organizer Information Technology & Electrical Engineering Department, ETH Zürich Teaching a fundamental Master's level course in control with over 70 students	Falls 2015, 2016
Hybrid Systems, Teaching assistant Electrical Engineering & Computer Sciences Department, UC Berkeley Designing course projects and mentoring students on their projects	Spring 2011
Nonlinear Control Systems, Guest lecturer Electrical Engineering & Computer Sciences Department, UC Berkeley (2 lectures) Mechanical Engineering Department, UC Berkeley (2 lectures)	Spring 2008
Intermediate Dynamics, Graduate student instructor Mechanical Engineering Department, UC Berkeley Teaching 2 hours per week, design and correction of assignments	Spring 2006
Calculus 2, Graduate student instructor Mathematics Department, UC Berkeley Teaching 3 hours per week, design and correction of assignments	Fall 2005

Service - Organization of Scientific Activities

Organized a mini-symposium in the SIAM Conference on Control & its Applications Title: Computational Approaches to Large Scale Stochastic Systems	Jul 2015
Co-organized Optimization & Application Seminars (IFOR), ETH Zürich	2014 - 2015
Co-organized a workshop in the European Control Conference Title: Verification & Control of Stochastic Hybrid Systems	Jul 2013
Co-organized an invited session in the European Control Conference Title: Generation and Load Side Control for Power Systems with Stochastic Uncertainty	Jul 2013
Initiated and organized a control systems reading group, UC Berkeley, USA	2006-2008

Service - Serving Doctoral Committees

- Ph.D. Committee, candidate: Tatiana Tatarenko, TU Darmstadt, Germany Feb 2017
- Ph.D. Committee, candidate: Olivier Megel, ETH Zürich, Switzerland Apr 2017

Invited Talks

- Control Systems Group, The University of Oxford, Oxford, England Apr 2016
Title: Stochastic Reachability: Theory, Applications and Computation
- Energy for a Smarter World Conference, EPFL, Lausanne, Switzerland Dec 2015
Title: A Control Theoretic Framework for Demand Response
- ABB Corporate Research, Baden, Switzerland Feb 2015
Title: Thermal Loads for Ancillary Services
- Dagstuhl Workshop, Schloss Dagstuhl, Germany Oct 2014
Title: Modeling, Verification, and Control of Complex Systems for Energy Networks
- Mechanical Engineering, The University of Queensland, Brisbane, Australia May 2014
Title: Verification & Control of Stochastic Hybrid Systems
- Electrical Engineering, TU Delft, The Netherlands Jun 2013
Title: Control Synthesis for Safety and Reachability of Stochastic Hybrid Systems
- Aeronautics & Astronautics, University of Washington, Seattle, WA, USA Apr 2012
Title: Air Traffic System Improvements through Optimal Control of Hybrid Systems
- Transportation Research Forum, Long Beach, CA, USA Mar 2011
Title: Modeling and Optimization of Air Traffic in Terminal Airspaces
- SIAM Optimization & Control Conference, Denver, CO, USA Jul 2009
Title: Optimal Control of Switched Systems

Poster and Video Presentations

- Swiss Nano-Tera Workshop, EPFL, Lausanne, Switzerland April 2016
Video: Put Your Buildings to Work! <https://www.youtube.com/watch?v=iCbcPQkghM>
- Mathematical Sciences Research Institute (MSRI), Berkeley, USA Jan 2007
Workshop on Connections for Women: Dynamical Systems
Poster: Survey on Control of Dynamical Systems over a Communication Channel

Review Activities

- IEEE Transactions on Automatic Control, IEEE Transactions on Smart Grid, Automatica, Nonlinear Analysis: Hybrid Systems, IEEE Transactions on Automation Science and Engineering, IEEE Transactions on Control Systems Technology

Professional Membership

- IEEE, IEEE Control Systems Society

Community Service

The Academic Association of Scientific Staff (AVETH), ETH Zürich Represented postdoctoral fellows and senior scientific staff Organized career planning workshops for scientific staff	2013-2015
Graduate Women in Engineering, UC Berkeley, USA Guided incoming female Ph.D. students in course selection and exams	2007-2011
Technology for Girls (TechGyrls), YWCA Berkeley Chapter, USA Developed engineering lesson plans for elementary school girls Taught mathematics and engineering lesson plans in weekly after school programs	2006-2011
Engineers Without Border, University of Waterloo Chapter, Canada Organized speaker series on engineering solutions for the developing world Coordinated shipment of computers to the Philippines for out-of-school unemployed youth	2004-2005
Multiculturalism Committee, Vancouver, Canada Mentored and tutored children of newly immigrated families	1999-2000

Masters' and Semester theses advised

Role: defining projects, weekly meeting, guidance in writeup of the results.

Semester projects at ETH are research projects carried out over thirteen weeks part-time.

Master's projects at ETH are research projects carried out over six months full-time.

1. Dzenan Lapandic, Semester project
Observability of a class of Fokker Planck Partial Differential Equations
ETH Zürich, July 2017
2. Daniel Hentzen, Semester project
Modeling stochastic weather forecast for aircraft trajectory planning
ETH Zürich, June 2017
3. Gian Ulli, Semester project
Robust mixed integer optimization for motion planning
ETH Zürich, Dec 2016
4. Jeremias Seitz, Master's project
Optimal HVDC control for transient stability of the power system
ETH Zürich, Dec 2016
5. Pier Giuseppe Sessa, Semester project
Game theoretic analysis of the Ancillary service electricity market
ETH Zürich, Aug 2016
6. Sebastian Curi, Semester project
Distributed optimization for electricity markets
ETH Zürich, Jun 2016
7. Hanmin Cai, Master's project
Modeling and control of electric water heaters and heat pumps
ETH Zürich, Aug 2015
8. Christoph Stäheli, Master's project
Primal and dual semidefinite algorithms for stochastic control
ETH Zürich, Aug 2015
9. Claudia Beyss, Master's project
Reachability and optimal control of power systems
ETH Zürich, May 2015
10. Adrian Gomez, Master's project
Control of distributed electric water heaters for ancillary services
ETH Zürich, Mar 2015
11. Alina Giger, Semester project
System identification and optimal control of an autonomous helicopter
ETH Zürich, Feb 2015
12. Christoph Stäheli, Semester project
Semidefinite programming for stochastic optimal control
ETH Zürich, Dec 2014

13. Adria Moler, Master's project ETH Zürich, Jul 2014
Multi-objective real-time path planning for emergency building evacuation
14. Natalie Le Claire, Semester project ETH Zürich, Jun 2014
System identification and control of a population of thermostatically controlled loads
15. Christoph Vömel, Semester project ETH Zürich, Dec 2013
Simulating the energy dynamics for a population of thermostatically controlled loads
16. Flavio Heer, Master's projects ETH Zürich, Sep 2013
Model based power optimization of wind farms
17. Flavio Heer, Semester projects ETH Zürich, May 2013
Modeling and optimization of power output of two wind turbines in a row
18. Carsten Heinrich, Semester project ETH Zürich, Feb 2013
Markov Chain modeling of aggregation of electric water heaters for demand response
19. Bratislav Svetozarevic, Semester project ETH Zürich, Oct 2012
Fault detection and isolation for a wind turbine
20. Mehdi Massoumy, Semester project UC Berkeley, May 2012
Optimal load management of aircraft power system
21. Katie Miller, Undergraduate research project UC Berkeley, Aug 2008
Path tracking control for quadrotor helicopters

Publication List

*: denotes authors with equal contribution

Journals

1. Y. Zheng, M. Kamgarpour, A. Sootla and A. Papachristodoulou, *Convex Design of Structured Controllers using Block-Diagonal Lyapunov Functions*, 2017, under review
2. T. Tatarenko and M. Kamgarpour, *Payoff-Based Approach to Learning Generalized Nash Equilibria in Convex Games*, under review, available at <https://arxiv.org/abs/1703.04113>, 2017
3. N. Kariotoglou, M. Kamgarpour, T. H. Summers and J. Lygeros, *A numerical approach to the reach-avoid problem for Markov decision processes*, under review, available at <http://arxiv.org/abs/1411.5925>, 2016
4. B. Gentile, F. Parise, D. Paccagnan, M. Kamgarpour and J. Lygeros, *Nash and Wardrop equilibria in aggregative games with coupling constraints*, provisionally accepted for IEEE Transactions on Automatic Control, available at <https://arxiv.org/abs/1702.08789>, 2017
5. D. Frick, T. A. Wood, G. Ulli, M. Kamgarpour, *Robust Control Policies given Formal Specifications in Uncertain Environments*, Systems & Control Letter, 2017, to appear
6. M. Kamgarpour, T. A. Wood, S. Summers and J. Lygeros, *Control Synthesis for Stochastic Systems given Automata Specifications defined by Stochastic Sets*, Automatica, 76:177-182, 2017
7. J. L. Mathieu, M. Kamgarpour, J. Lygeros, G. Andersson and D. S. Callaway, *Arbitraging Intraday Wholesale Energy Market Prices with Aggregations of Thermostatic Loads*, IEEE Transactions on Power Systems, 30(2):763-772, Mar 2015
8. X. Zhang, M. Kamgarpour, A. Georghiou, P. Goulart and J. Lygeros, *Robust Optimal Control with Adjustable Uncertainty Sets*, Automatica, 75:249-259, available at <https://arxiv.org/abs/1511.04700>, 2017
9. M. Soler, M. Kamgarpour, J. Lloret and J. Lygeros, *A Hybrid Optimal Control Approach to Fuel Efficient Aircraft Conflict Avoidance*, IEEE Transactions on Intelligent Transportation Systems, 17(7):1826-1838, Jul 2016

10. S. Summers*, M. Kamgarpour*, C. Tomlin and J. Lygeros, *Stochastic System Controller Synthesis for Reachability Specifications Encoded by Random Sets*, *Automatica*, 49(9):2906-2910, 2013
11. J. Ding*, M. Kamgarpour*, S. Summers, A. Abate, J. Lygeros and C. Tomlin, *A Stochastic Games Framework for Verification and Control of Discrete Time Stochastic Hybrid Systems*, *Automatica*, 49(9):2665-2674, 2013
12. W. Zhang, M. Kamgarpour, D. Sun and C. Tomlin, *A Hierarchical Flight Planning Framework for Air Traffic Management*, *Proceedings of the IEEE*, 100(1):179-194, 2012
13. M. Kamgarpour and C. Tomlin, *On Optimal Control of Non-Autonomous Switched Systems under a Fixed Switching Sequence*, *Automatica*, 48(6):1177-1181, 2012

Peer-reviewed conference proceedings

1. L. Furieri and M. Kamgarpour, *Finite Horizon Structured Robust Control for Constrained Systems*, 2017, under review
2. O. Karaca and M. Kamgarpour, *Game Theoretic Analysis of Electricity Market Auction Mechanisms*, 2017, under review
3. Y. Zheng, M. Kamgarpour and A. Papachristodoulou, *A Convex Approach to Design of Structured Feedback Gains using Block-diagonal Lyapunov Functions*, 2017, under review
4. D. G. Gonzalez-Arribas, D. Hentzen, M. Sanjurjo-Rivo, M. Soler and M. Kamgarpour, *Optimal Aircraft Trajectory Planning in the Presence of Stochastic Convective Weather Cells*, AIAA Aviation Conference, Denver, CO, USA, 2017, to appear
5. P. G. Sessa, N. Walton and M. Kamgarpour, *The Vickrey-Clarke-Groves mechanism for electricity markets*, *Proceedings of the IFAC World Congress*, available at <https://arxiv.org/abs/1611.03044>, Jun 2017, to appear
6. T. Tatarenko and M. Kamgarpour, *Pay-off based approach to learning Nash equilibria in convex games*, 2016, *Proceedings of the IFAC World Congress*, available at <https://arxiv.org/abs/1611.10156>, Toulouse, France, 2017, to appear
7. M. Kamgarpour and T. Summers, *On infinite dimensional linear programming approach to stochastic control*, *Proceedings of the IFAC World Congress*, available at <https://arxiv.org/abs/1611.10164>, Toulouse, France, 2017, to appear
8. T. Summers, C. Li and M. Kamgarpour, *Information Structure Design in Team Decision Problems*, under *Proceedings of the IFAC World Congress*, Toulouse, France, 2017, to appear
9. F. Farshidian, M. Kamgarpour, D. Pardo and J. Buchli, *Sequential Linear Quadratic Optimal Control for Nonlinear Switched Systems*, *Proceedings of the IFAC World Congress*, Toulouse, France, 2017, to appear
10. B. Gentile, D. Paccagnan, F. Parise, M. Kamgarpour and J. Lygeros, *Distributed computation of generalized Nash equilibria in quadratic aggregative games with affine coupling constraints*, *IEEE Conference on Decision and Control*, Las Vegas, USA, Dec 2016
11. M. Kamgarpour, C. Beyss and A. Fuchs, *Nonlinear Reachability and Optimal Control Synthesis for Power System Stability*, *IFAC Conference on Control of Transmission and Distribution Grid*, pp. 238-243, Prague, Czech Republic, Oct 2016
12. T. A. Wood and M. Kamgarpour, *Automaton-Based Stochastic Control for Navigation of Emergency Rescuers in Buildings*, *Multi-conference on Control*, pp. 587-592, Buenos Aires, Argentina, Aug 2016
13. M. Kamgarpour and T. Summers, *Stochastic Control: A Moment Approach to Sparse Control Design*, *Mathematical Theory of Networked Systems*, pp. 279-282, Minneapolis, Minnesota, Jul 2016

14. D. Držajić, N. Kariotoglou, M. Kamgarpour and J. Lygeros, *A Semidefinite Programming Approach to Control Synthesis for Stochastic Reach-Avoid Problems*, Applied Verification for Continuous and Hybrid Systems, EPiC Series in Computing, vol:43, pp.134-143, 2017
15. D. Paccagnan, M. Kamgarpour and J. Lygeros, *On Aggregative and Mean Field Games with Applications to Electricity Markets*, Proceedings of the European Control Conference, pp. 196-201, Aalborg, Denmark, Jul 2016
16. D. Paccagnan, M. Kamgarpour and J. Lygeros, *On the Range of Feasible Power Trajectories for a Population of Thermostatically Controlled Loads*, IEEE Conference on Decision and Control, pp.5883-5888, Osaka, Japan, Dec 2015
17. X. Zhang*, E. Vrettos*, M. Kamgarpour and J. Lygeros, *Stochastic Frequency Reserve Provision by Chance-constrained Control of Commercial Buildings*, European Control Conference, pp. 1134-1140, Linz, Austria, Jul 2015
18. X. Zhang, M. Kamgarpour, P. Goulart and J. Lygeros, *Selling Robustness Margins: A Framework for Optimizing Reserve Capacities for Linear Systems*, IEEE Conference on Decision and Control, pp. 6419-6424, Los Angeles, CA, USA, Dec 2014
19. F. Heer, P. Mohajerin Esfahani, M. Kamgarpour and J. Lygeros, *Model Based Power Optimization of Wind Farms*, European Control Conference, pp.1145-1150, Strasbourg, France, Jun 2014
20. M. Soler, M. Kamgarpour and J. Lygeros, *A Numerical Framework and Benchmark Case study for Multi-modal Fuel Efficient Aircraft Conflict Avoidance*, International Conference on Research in Air Transportation, Istanbul, Turkey, May 2014
21. M. Maasoumy, P. Nuzzo, F. Iandola, M. Kamgarpour, C. Tomlin and A. Sangiovanni-Vincentelli, *Optimal Load Management System for Aircraft Electric Power Distribution*, IEEE Conference on Decision and Control, pp.2939-2945, Florence, Italy, Dec 2013
22. M. Kamgarpour, C. Ellen, S. Esmaeil Zadeh Soudjani, S. Gerwinn, J. L. Mathieu, N. Müllner, A. Abate, D. S. Callaway, M. Fränzle and J. Lygeros, *Modeling Options for Demand Side Participation of Thermostatically Controlled Loads*, IREP Bulk Power System Dynamics & Control Symposium, Rithymna, Crete, Greece, Aug 2013
23. M. Kamgarpour and H. Tembine, *A Bayesian Mean Field Game Approach to Supply Demand Analysis of the Smart Grid*, IEEE Black Sea Conference on Communications and Networking, pp.196-200, Batumi, Georgia, Jul 2013
24. J. L. Mathieu, M. Kamgarpour, J. Lygeros and D. S. Callaway, *Energy Arbitrage with Thermostatically Controlled Loads*, European Control Conference, pp.303-312, Zürich, Switzerland, Jul 2013
25. N. Kariotoglou, S. Summers, T. Summers, M. Kamgarpour and J. Lygeros, *Approximate Dynamic Programming for Stochastic Reachability*, European Control Conference, pp.584-589, Zürich, Switzerland, Jul 2013
26. T. H. Summers, K. Kunz, N. Kariotoglou, M. Kamgarpour, S. Summers and J. Lygeros, *Approximate Dynamic Programming via Sum of Squares Programming*, European Control Conference, pp.191-197, Zürich, Switzerland, Jul 2013
27. B. Svetozarevic, P. Mohajerin Esfahani, M. Kamgarpour and J. Lygeros, *A Robust Fault Detection and Isolation Filter for a Horizontal Axis Variable Speed Wind Turbine*, American Control Conference, pp.4453-4458, Washington, DC, USA, Jun 2013
28. M. Kamgarpour, S. Summers and J. Lygeros, *Control Design for Property Specifications on Stochastic Hybrid Systems*, In C. Belta and F. Ivancic, editors, Hybrid Systems: Computation and Control, ACM Lecture Notes in Computer Science, pp.303-312, Philadelphia, PA, USA, Apr 2013

29. M. Soler, M. Kamgarpour, C. Tomlin and E. Staffetti, *Multiphase Mixed-Integer Optimal Control Framework for Aircraft Conflict Avoidance*, IEEE Conference on Decision and Control, pp.1740-1745, Maui, HI, USA, Dec 2012
30. M. Kamgarpour*, J. Ding*, S. Summers, A. Abate, J. Lygeros and C. Tomlin, *Discrete-Time Stochastic Hybrid Dynamical Games: Verification and Controller Synthesis*, IEEE Conference on Decision and Control, pp.6122-6127, Orlanado, FL, USA, Dec 2011
31. M. Kamgarpour, W. Zhang and C. Tomlin, *Modeling and Optimization of Terminal Airspace and Aircraft Arrival subject to Weather Uncertainties*, AIAA Guidance, Navigation and Control Conference, pp.6516-6521, Portland, OR, USA, Oct 2011
32. M. Kamgarpour, M. Soler, C. Tomlin, A. Olivares and J. Lygeros, *Hybrid Optimal Control for Aircraft Trajectory Design with a Variable Sequence of Modes*, IFAC World Congress, pp.7238-7243, Milan, Italy, Aug 2011
33. W. Zhang, M. Kamgarpour, D. Sun and C. Tomlin, *Decentralized Flight Path Planning for Air Traffic Management*, American Control Conference, pp.2137-2142, San Francisco, CA, USA, Jun 2011
34. S. Summers, M. Kamgarpour, C. Tomlin and J. Lygeros, *A Stochastic Reach-Avoid Problem with Random Obstacles*, In E. Frazzoli and R. Grosu, editors, *Hybrid Systems: Computation and Control*, ACM Lecture Notes in Computer Science, pp.251-260, Chicago, IL, USA, Apr 2011
35. H. Gonzalez, R. Vasudevan, M. Kamgarpour, S. Sastry, R. Bajcsy and C. Tomlin, *A Numerical Method for the Optimal Control of Switched Systems*, IEEE Conference on Decision and Control, pp.7519-7526, Atlanta, GA, USA, Dec 2010
36. M. Kamgarpour, V. Dadok and C. Tomlin, *Trajectory Generation for Multiple Aircraft subject to Dynamic Weather Uncertainty*, IEEE Conference on Decision and Control, pp.2063-2068, Atlanta, GA, USA, Dec 2010
37. J. Robinson and M. Kamgarpour, *Benefits of Continuous Descent Operations in High-Density Terminal Airspace under Scheduling Constraints*, AIAA Aviation Technology, Integration and Operations Conference, pp.1-21, Fort Worth, TX, USA, Sep 2010
38. M. Kamgarpour and C. Tomlin, *Modeling and Analysis of Cell Differentiation using Hybrid Systems*, American Control Conference, pp.4355-4360, Baltimore, MD, USA, Jun 2010
39. H. Gonzalez, R. Vasudevan, M. Kamgarpour, S. Sastry, R. Bajcsy and C. Tomlin, *Computable Optimal Control of Switched Systems with Constraints*, In K. H. Johansson and W. Yi, editors, *Hybrid Systems: Computation and Control*, ACM Lecture Notes in Computer Science, pp.51-60, Stockholm, Sweden, Apr 2010
40. M. Kamgarpour and C. Tomlin, *Convergence Properties of a Decentralized Kalman Filter*, IEEE Conference on Decision and Control, pp.3205-3210, Cancun, Mexico, Dec 2008
41. S. Jackson, J. Tisdale, M. Kamgarpour, B. Basso and K. Hedrick, *Tracking Controllers for Small UAVs with Wind Disturbances: Theory and Flight Results*, IEEE Conference on Decision and Control, pp.3205-3210, Cancun, Mexico, Dec 2008

Patents

1. T. Wood, S. Summers, M. Kamgarpour and J. Lygeros, *Support to emergency evacuation*, EP Patent App. EP20,130,005,725, url=<https://www.google.ch/patents/EP2881707A1?cl=en>, 2013