

Noel E. Du Toit

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EDUCATION

California Institute of Technology Pasadena, CA
Ph.D., Mechanical Engineering February 2010
Relevant coursework: Classical-, Modern-, Robust-, and Adaptive Control Theory, Estimation Theory, System Identification, Dynamical Systems, Robot Kinematics, Robot Motion Planning, Stochastic System Modeling

Massachusetts Institute of Technology Cambridge, MA
M.S., Aeronautics and Astronautics June 2005

University of Stellenbosch Stellenbosch, South Africa
B.Eng. (Mech), Mechanical Engineering (*Cum Laude*) December 2001

RESEARCH EXPERIENCE

California Institute of Technology Pasadena, CA
Postdoctoral Scholar: Controls and Dynamical Systems
Advisor: Dr. Richard Murray June 2010 - present

- Develop a planner for a quadrotor robot and support platform setup and installation
- Update and maintain Caltech's DARPA Urban Challenge code-base
- Implement a real-time trajectory planner based on Ph.D. research and results

Research Assistant: Robot Motion Planning in Dynamic, Uncertain Environments

Ph.D. Thesis Advisor: Dr. Joel W. Burdick November 2007 – February 2010

Investigated the use of future information in robot motion planning to reduce the growth of uncertainty during system propagation. This reduction in uncertainty is key to obtaining efficient solutions in cluttered, dynamic environments, and for using more complicated agent behavioral models.

- Incorporated future measurements of the robot and agents states in the planning process
- Accounted for the quality of information about the dynamic agents during the planning process
- Implemented multimodal behavioral models for agents and accounted for all modes during motion planning
- Developed a probabilistic obstacle avoidance approach that accounts for robot and obstacle uncertainty
- Demonstrated the benefit of the obtained algorithm over state-of-the-art approaches in simulation

Student Coordinator: Team Caltech Navigation Team, DARPA Urban Challenge

Advisors: Dr. Richard M. Murray and Dr. Joel W. Burdick June 2006 – October 2007

- Coordinated the Navigation Team (8-16 members) for Team Caltech, including task planning, team management, and system-level representation
- Supervised the development, implementation, documentation, and testing of a planning architecture for autonomous urban navigation on Alice, the Team Caltech autonomous vehicle
- Designed, implemented, and documented a tactical planner that obeyed traffic rules, navigated road networks, and interacted with other agents

Research Assistant: Highway Navigation using Potential Field Methods

Advisor: Dr. Joel W. Burdick August 2005 – May 2006

- Investigated an interactive robot-agent framework for highway navigation based on potential field theory
- Extended existing simulations to allow agents to react to the robot, and vice versa

Massachusetts Institute of Technology Cambridge, MA
Research Assistant: Modeling and Design of a MEMS Piezoelectric Vibration Energy Harvester

M.S. Thesis Advisor: Dr. Brian L. Wardle September 2003 – June 2005

- Developed and experimentally verified a model for a cantilevered piezoelectric vibration harvester
- Fabricated a first-generation MEMS prototype device and designed a second-generation MEMS-scale device

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RESEARCH EXPERIENCE (CONTINUED)

University of Stellenbosch

Stellenbosch, South Africa

Research Assistant: An Investigation into Mixed Flow Fans

B.S. Thesis Advisor: Dr. Theo von Backström

January 2001 – December 2001

- Developed and implemented an analysis tool for mixed flow fans where conventional methods fail
- Experimentally validated the analysis tool and designed a second generation prototype fan

TEACHING EXPERIENCE

California Institute of Technology

Pasadena, CA

Lecturer: Mechanical Engineering Design Laboratory

Co-instructor: Dr. Joel W. Burdick

October 2009 – March 2010

- Supervised teaching assistants and instructed students during the design, implementation, and testing phases
- Participated in competition specification and acted as corporate sponsor liaison

Teaching Assistant: Mechanical Engineering Laboratory

Instructor: Dr. David A. Boyd

March 2009 – May 2009

- Updated, documented, and maintained experimental apparatus
- Trained, instructed and evaluated students on proper experimental methodology

WORK EXPERIENCE

University of Stellenbosch

Stellenbosch, South Africa

Engineer in Training: Vibration and Controls Laboratory

Supervisor: Dr. Wikus van Niekerk

September 2002 – May 2003

- Implemented a controller for a man-rated seat-shaker facility
- Performed dynamic response analysis of commercial suspension seats to verify conformance with standards

DaimlerChrysler Corporation

East London, South Africa

Student Intern: Facilities Planning Office

Supervisor: Mr. Errol Scheepers

December 2000 – January 2001

- Designed automated lock-nut crimping tool for use on production line
- Improved yield and repeatability of task, lowered the required physical exertion, and decreased task duration

Denel Aviation

Irene, South Africa

Student Intern: Rooivalk Design Office

Supervisor: Mr. Gordon Ferguson

June 2000 – July 2000

- Researched the application of alternative power plants in general aviation and the availability of fuels
- Redesigned a composite material cutter to reduce operating costs by 85%

PUBLICATIONS

Du Toit, N.E. and Burdick, J.W., “Robotic Motion Planning in Dynamic, Cluttered, Uncertain Environments”, in *Proc. IEEE Int Conf Robotics and Automation*, pp. 966-973, Anchorage, AK, May 3-7, 2010

Du Toit, N.E. and Burdick, J.W., “Robot Motion Planning in Dynamic, Cluttered, Uncertain Environments”, *submitted to IEEE Transactions on Robotics*

Du Toit, N.E. and Burdick, J.W., “Probabilistic Collision Checking with Chance Constraints”, *submitted to IEEE Transaction on Robotics*

Du Toit, N.E., “Robot Motion Planning in Dynamic, Cluttered, and Uncertain Environments: the Partially Closed-Loop Receding Horizon Control Approach”, *Ph.D. thesis, California Inst. of Tech.*, Pasadena, CA, February 2010

Du Toit, N.E., Looman, C., Burdick, J.W., Murray, R.M., “Imposing Behaviors on Robots in Complex Environments” *manuscript in preparation*

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PUBLICATIONS (CONTINUED)

Du Toit, N.E., Wongpiromsarn, T., Burdick, J.W., and Murray, R.M., “Situational Reasoning for Road Driving in an Urban Environment” presented at IVCS 2008 (ICINCO 2008), Funchal, Madeira, May 11-15, 2008

Du Toit, N.E. and Wardle, B.L., “Experimental Verification of Models for Microfabricated Piezoelectric Vibration Energy Harvesters” *AIAA Journal*, Vol. 45, No. 5, pp. 1126-1137, 2007

Du Toit, N.E., and Wardle, B.L., “Performance of Microfabricated Piezoelectric Vibration Energy Harvesters” *Integrated Ferroelectrics, An International Journal*, Vol. 83, pp. 13-32, 2006

Du Toit, N.E., “Modeling and Design of a MEMS Piezoelectric Vibration Energy Harvester”, *M.S. thesis, Massachusetts Inst. of Tech.*, Cambridge, MA, June 2005

Du Toit, N.E., Wardle, B.L., and Kim, S.G., “Design Considerations for MEMS-scale Piezoelectric Mechanical Vibration Energy Harvesters” *Integrated Ferroelectrics, An International Journal*, Vol. 71, pp. 121-160, 2005

Du Toit, N.E., “An Investigation into Mixed-Flow Fans”, *B.Eng. thesis, University of Stellenbosch*, Stellenbosch, South Africa, December 2001

COMPUTER SKILLS

Knowledge: C++, MATLAB, Unix operating systems (Linux and Mac OSX)

Working knowledge: ROS, Simulink, TOMLAB, LabVIEW, Player/Stage

SCHOLARSHIPS, HONORS, AND AWARDS AND AFFILIATIONS

Scholarships: Study scholarship: Industrial Development Corporation, SA (1998 – 2001)

Merit scholarship: University of Stellenbosch (1998 – 2001)

Awards: AECI, Inc. Award for First in Class (1998)

SASOL, Inc. Award for First in Class (1999, 2000)

Frank Carnell Award for Best Thesis in Aeronautical Engineering (2001)

Honors: Academic Honors, University of Stellenbosch (2001)

Golden Key International Honor Society

PROFESSIONAL ACTIVITIES

Professional affiliations: American Society of Mechanical Engineers (ASME)

American Institute of Aeronautics and Astronautics (AIAA)

Institute of Electrical and Electronics Engineers (IEEE)

Paper Reviews: International Conference on Field and Service Robotics (FSR)

International Conference on Intelligent Robots and Systems (IEEE/RSJ IROS)

International Conference on Robotics and Automation (IEEE ICRA)

REFERENCES

Prof. Joel Burdick
Mechanical Engineering, Caltech
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(626) 395-4139
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Prof. Richard Murray
Control and Dynamical Systems, Caltech
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(626) 395- 6460
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Dr. Andrew Howard
Space Exploration Technologies
1 Rocket Rd, Hawthorne, CA 90250
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