Craig R. Carignan

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EDUCATION

University of New Hampshire, Durham, NH
B.S. candidate, Chemical Engineering — September 1976 – May 1978, GPA: 3.9/4.0

Massachusetts Institute of Technology, Cambridge, MA
B.S., Aeronautics & Astronautics — September 1978 – December 1980, GPA: 4.8/5.0

Massachusetts Institute of Technology, Cambridge, MA
M.S., Aeronautics & Astronautics — February 1981 – June 1982, GPA: 4.8/5.0

Massachusetts Institute of Technology, Cambridge, MA
Ph.D., Controls & Dynamics — June 1982 – August 1987, GPA: 4.8/5.0

WORK EXPERIENCE

Robotics Engineer — January 2010 – present
NASA Goddard Space Flight Center, Satellite Servicing Projects Division (SSPD)
- Supported software development for robot used to support ground operations for the Robotic Refueling Mission (RRM)
- Developed inverse kinematics and compliance control software for a seven-axis robot for a satellite servicing testbed (Restore-L)
- Helped develop inverse kinematics algorithms used for the servicing arms on the Asteroid Robot Redirect Mission (ARRM)

Rehabilitation Robotics, Group Leader — October 2002 – September 2009
Imaging Science and Information Systems Center, Georgetown University, Washington DC
- Project lead for developing robotic devices for physiotherapy of patients over the Internet
- Project lead to design and build a six-axis arm exoskeleton for shoulder rehabilitation
- Led pilot study on using InMotion2 robot to study neurological learning for Parkinson's Disease patients

Assoc. Research Scientist, Lead Engineer — September 2009 – November 2010
Space Systems Laboratory, University of Maryland, College Park, MD
- Lead robotics engineer on a NSF grant to design and build a manipulator sampling system for an autonomous underwater vehicle.
- Served as a contract officer representative for the U.S. Army Telemedicine and Advanced Technology Research Center (TATRC) on several projects in the Medical Robotics and Advanced Prosthetics and Human Performance portfolios (under IPA agreement).

Robotics Engineer — November 2007 – July 2009
Mega Engineering, Silver Spring, MD
- Rewrote robot kinematics software for a FANUC manipulator used to simulate docking operations with a Hubble Space Telescope mockup at the NASA Goddard Space Flight Center.
- Assisted with the impedance control analysis for flight operations.

Satellite Engineer — March 1992 – September 1992
Ithaco Technical Services, Lanham, Maryland
- Designed pointing control system for the Submillimeter Wave Astronomy Satellite (SWAS) for NASA Small Explorer Program.
- Used Matlab to design a digital feedback regulator for generating reaction wheel commands from gyroscope data.
- Attended weekly project meetings and presented results at design reviews.

Research Associate — August 1991 – October 2002
Space Systems Laboratory, University of Maryland, College Park, MD
- Lead robotics engineer on an underwater robot used for neutral buoyancy simulation of on-orbit servicing.
- Developed real-time code to control several onboard manipulators from a VME processor interfacing a SGI control station.
- Supervised the development of the vehicle prototype and directed operational testing of the vehicle in neutral buoyancy.
- Additional responsibilities included advising student researchers, teaching graduate courses, and writing research proposals.

Sr. Robotics Engineer, NASA Task Leader — November 1987 – November 1991
Hughes/STX Corporation, Lanham, Maryland
- Task leader on a NASA project to develop and test control systems for a robot testbed.
- Conducted experiments on an adaptive force-reflecting hand controller
- Wrote algorithms for implementing a force controller on a seven-joint manipulator arm.
- Member of the critical design review team for the Space Shuttle Demonstration Test Flight (DTF) Experiment.

Graduate Research Assistant, Ph.D. Candidate
Massachusetts Institute of Technology, Dept. of Aeronautics and Astronautics

January 1983 – September 1987

- Developed inertial tracking controller for satellite-mounted manipulators.
- Research included dynamic modeling, sliding-mode control, distributed optimization, and dual-arm manipulation.
- Designed and constructed a free-floating robot for testing the control algorithms on an air-bearing table.
- PhD Dissertation: *Control Strategies for Manipulating Payloads in Weightlessness with a Free-Flying Robot.*

Satellite Engineer, Summer Intern
June 1983 – September 1983
Ford Aerospace Corporation, Palo Alto, California

- Designed a failure detection system for two spacecraft gyro configurations based on generalized likelihood testing.
- Compared performances using Bayesian error analysis and dynamic simulation.

Systems Engineer, Draper Fellow
June 1982 – December 1982
Charles Stark Draper Laboratory, Cambridge, Massachusetts

- Investigated the reliability of a terrain following system for a tactical fighter with interdependent collision avoidance systems.
- Performed risk analysis using Markov modeling methods.

Graduate Research Assistant, M.S. Candidate
February 1981 – June 1982
Massachusetts Institute of Technology, Dept. of Aeronautics and Astronautics

- Helped develop metrics for optimal actuator and sensor placement on large space structures.
- Designed failure detection filters for diagnosing component failures in large scale systems.
- M.S. Dissertation: *Filter Failure Detection for Systems with Large Space Structure Dynamics.*

Attitude Control System Engineer, Summer Intern
June 1980 – September 1980
Hughes Space & Communications Group, Hughes Aircraft Co., El Segundo, California

- Assisted in the design of a gyrocompass and state estimator for the Venus Orbiting Imaging Radar (VOIR) satellite.
- Compared tracking performance with a classical feedback control system using dynamic simulation.

HONORS AND AWARDS

Robotics Engineer
January 2005 – July 2005
American Android, Princeton, NJ

- Conducted a survey of the autonomy level of current space robotics assets for Phase I SBIR effort and delivered final report.
- Developed autonomy metrics based on robot functionalities for on-orbit and planetary surface operations.

Robotics Engineer
January 2004 – December 2006
Space Systems Laboratory, University of Maryland, College Park, MD

- Developed control system for a manipulator on an undersea vehicle used for polar exploration on a joint project with the Woods Hole Oceanographic Institute to conduct autonomous sampling of hydrothermal vents beneath the polar ice cap.

Test Engineer
September 2003 – June 2005
Dept. of Kinesiology, University of Maryland, College Park, MD

- Developed MATLAB programs to analyze data from tests performed on a leg curl machine in an experimental study on strength training in older adults (GUSTO).
- Helped diagnose problems related to calibration of the weight machine
- Assisted with writing research publications.

Manufacturing Engineer
August 1998 – December 1998
Technology Extension Service, University of Maryland, College Park, MD

- Developed software for laser cutting of templates being developed by a local company as part of a "next-generation" manufacturing process for an "Autopen". Used robotics modeling techniques and Matlab to develop and test the software.

SKILLS AND CERTIFICATIONS

Computer Skills:

- Operating Systems: Mac OSX, Windows XP, Linux
- Programming Languages: C, C++
- Software Applications: Matlab, Mathematica
- Platforms: MS Visual Basic, Xcode, Orocos

Areas of Expertise:

- Robot Kinematics and Dynamics
- Robot Compliance Control
- Robotic Exoskeletons
- Rehabilitation Robotics
- Haptic Interfaces
- Software Engineering

PATENTS

7,862,524	Portable Arm Exoskeleton for Shoulder Rehabilitation (issued: January 4, 2011)

TEACHING EXPERIENCE

Introduction to Space Robotics, University of Maryland	2019, 2017, 2015, 2013, 2011, 2009, 2005 2003, 1997, 1995, 1992
Anthropomorphic Robotics, University of Maryland	2012
Haptic Controls and Applications, University of Maryland	1998
Control of Robot Manipulators, University of Maryland	1994
Applied Digital Control, University of Maryland	1992
Astrodynamics, University of Maryland	1991

HONORS AND AWARDS

NASA Exceptional Achievement for Engineering Team	2013
U.M. Interfraternity Council Faculty Advisor of the Year	1999, 2001
Best Paper Award, AIAA Modeling and Simulation Technologies Conference	1999
M.I.T. Doctoral Research Assistantship	1983-1987
C.S. Draper Laboratory Fellowship	1982
M.I.T. Masters Research Assistantship	1981-1982
James Means Memorial Prize in Aerospace Engineering	1981
Manchester Union Leader Annual Journalism Award	1976

CONFERENCE WORKSHOPS (CO-ORGANIZED)

Robotic In-Situ Manufacturing, Structural Assembly and Servicing	IEEE Intl. Conf. on Robotics and Automation, Paris, France	June 2020
Robotic Technology for In-Space Assembly	IEEE Intl. Conf. on Robotics and Automation, Montreal, Canada	May 2019
Gravity Offload Testbeds for Space Robotic Mission Simulation	IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems, Vancouver, BC, Canada	Sept. 2017
The Next Generation of Space Robotic Servicing Technologies	IEEE Intl. Conf. on Robotics and Automation, Seattle, Wash.	May, 2015
Robotic Satellite Servicing	IEEE Intl. Conf. on Robotics and Automation, St. Paul, Minnesota	May, 2012
Workshop: Robotic Technologies for Rehabilitation (presenter)	IEEE Intl. Conf. on Robotics and Automation, Rome, Italy	April, 2007
Medical Robotics and Welfare (presenter)	IEEE Intl. Conf. on Robotics and Automation, Barcelona, Spain	April, 2005

INVITED TALKS/SEMINARS

Univ. of Maryland Kinesiology (KHU exchange students)	7/23/2014	Engineering Technologies and Public Health: *Robotics for Rehabilitation & Advanced Human Performance*
State of the Science Symposium, Walter Reed Army Medical Center	1/22/2010	Technologies for People with Disabilities: *Shoulder Exercise and Rehabilitation with the MGA Exoskeleton*
NSCA Penn State Strength & Conditioning Clinic, Juniata College	6/12/2009	*Shoulder Exercise and Rehabilitation with a Robotic Arm Exoskeleton*
Technical Focus Group Presentation, Booz-Allen-Hamilton	5/8/2009	Emerging Technologies: *New Solutions for Treating Shoulder/Arm Injury: The MGA Exoskeleton*
NSCA Penn State Strength & Conditioning Clinic, Juniata College	6/27/2008	*Robotic Arm Exoskeletons for Strength Training and Rehabilitation*
IEEE Washington DC/NOVA Symposium: Technology for the Golden Years	5/10/2008	*A Robotic Arm Exoskeleton for Shoulder Rehabilitation*
IEEE Int. Conf. on Robotics and Automation, Rome, Italy	Apr. 2007	Workshop SF-08: Robotic Technologies for Rehabilitation *Shoulder Rehabilitation using the MGA Arm Exoskeleton*
Georgetown University Course: PHAR 804	10/4/2005	Biomedical Device Discovery & Development: *Upper Limb Robotic Rehabilitation: Three Case Studies*
IEEE Int. Conf. on Robotics and Automation, Barcelona, Spain	Apr. 2005	Workshop WF-03: Medical Robotics and Welfare*: Design and Operation of a Robotic Arm Exoskeleton for Shoulder Rehabilitation*
Catholic University of America Course BE 491	3/21/2005	Biomedical Engineering: *Rehabilitation Robotics: Bright Lights, Big Future?*
Catholic University of America Course ENGR 552:	3/10/2003	Introduction to Imaging Technologies: *Module IV: Rehabilitation Robotics*

VOLUNTEER SERVICES

NSF Review Panel, Robotics SBIR Phase I	2010, 2013
IEEE VR Conf./Haptic Interfaces Symp. Local Coordinator	2006
NSF Review Panel, Biomedical Engineering and Research to Aid Disabilities	2003 – 2005
Fords Theatre, Washington DC, Volunteer	2009 – 2020
Studio Theatre, Washington DC, Volunteer	2007 – 2017
Signature Theatre, Arlington VA, Volunteer	2006 – 2019
Shakespeare Theatre Company, Washington DC, Volunteer	2003 – 2020
Undergraduate Academic Advisor, Dept. of Letters and Sciences	1994 – 2002
Greek Life Vision Standards Review Committee	1999 – 2002
Washington Project for the Arts\Corcoran Volunteer	1998 – 2001
Faculty Advisor, Pi Kappa Alpha Fraternity	1998 – 2011
OASIS Tutoring Program Volunteer	1998 – 1999
Children's Development Workshop Clinician	1995 – 1998
SCUBA Teaching Assistant	1995 – 1997

OTHER INTERESTS

- Maryland Community Band (player, board of directors, venue committee chair)
- Volleyball Doubles, Tennis, Mountain Biking, Hiking
- SCUBA Diver (NAUI certified: Open Water, Advanced, Rescue)
- Certified Personal Trainer (NCSF)
- Skywarn Storm Spotter, National Weather Service

PUBLICATIONS

Journal Articles:

Carignan C, Krebs HI. "Telerehabilitation Robotics: Bright Lights, Big Future?" *J. of Rehabilitation Research and Development* 43(5): 695-710, Aug./Sept. 2006

Carignan C, Olsson AP, Tang J. "Cooperative control of virtual objects using haptic teleoperation over the internet." *Int. J. on Disability and Human Development* 4(4): 261-267, Oct.-Dec. 2005

Carignan C, Akin D. "Using Robots for Astronaut Training." *IEEE Control Systems Magazine* 23(2): 46-59, Apr. 2003

Carignan C, Lane JC, Akin D. "Control Architecture and Operator Interface for a Free-Flying Robotic Vehicle." *IEEE Transactions on Systems, Man, and Cybernetics Part C: Applications and Reviews* 31C(3): 327-336, Aug. 2001

Lane JC, **Carignan C**, Akin D. "Advanced Operator Interface Design for Complex Space Telerobots." *Autonomous Robots 11,* Kluwer Academic Publishers, 49-58, 2001

Carignan C, Akin D. "Reaction Stabilization of On-Orbit Robots." *IEEE Control Systems Magazine* 20(6): 19-33, Dec. 2000

Carignan C, Howard R. "A Partitioned Redundancy Management Scheme for an Eight-Joint Revolute Manipulator." *J. Robotic Systems* 17(9): 453-468, Sept. 2000

Carignan C, Cleary K. "Closed-Loop Force Control for Haptic Simulation of Virtual Environments." *Haptics-e, The Electronic Journal of Haptics Research (https://digital.lib.washington.edu/researchworks/handle/1773/34880)* 2(2): 1-14, Feb. 2000

Carignan C. "Trajectory Optimization for Kinematically Redundant Arms." *J. Robotic Systems* 8(2): 221-248, Apr. 1991

Carignan C, Akin D. "Optimal Force Distribution for Payload Positioning Using a Planar Dual-Arm Robot." *J. Dynamic Systems, Measurement, and Control* 111(2): 205-210, June 1989

Carignan C, Akin D. "Cooperative Control of Two Arms in the Transport of an Inertial Load in Zero-Gravity." *IEEE J. Robotics and Automation* 4(4): 414-419, Aug. 1988

VanderVelde W, **Carignan C**. "Number and Placement of Control System Components Considering Possible Failures." *J. Guidance, Control and Dynamics* 7(6): 703-709, 1984 (reprinted in Soviet Aeronautics/Space Technology, Dec. 1985)

Book Chapters:

Roderick S, **Carignan C**. "Designing Safety-Critical Rehabilitation Robots, In: Rehabilitation Robotics." S. Kommu (Ed.), pp. 43-64, I-Tech Education and Publishing, Vienna, 2007

Refereed Conference Papers:

Knizhnik J, Austin M, **Carignan C**. "Robotic Satellite Servicing Trade Space Down-Selection." *Proc. 27th INCOSE International Symposium (IS 2017)*, Adelaide, Australia, July 2017

James T**, Carignan C**. "Exoskeleton Wrist Design using Composite Visualization Methods." *Proc. ASME Int. Mechanical Engineering Congress and Exposition (IMECE)*, Phoenix, Nov. 2016

Chambers J, **Carignan C**, Wereley N. "Powering a Lower Limb Exoskeleton using Pneumatic Artificial Muscles." *Proc. ASME Int. Mechanical Engineering Congress and Exposition (IMECE)*, Phoenix, Nov. 2016

Wilson E, Ding J, **Carignan C**, Krishnan K, Avila R, Turner W, Stoianovici D, Yankelevitz D, Banova F, Cleary K. "Evaluation of nonholonomic needle steering using a robotic needle driver." *Proc. SPIE Medical Imaging/Visualization, Image-Guided Procedues and Modeling Conference,* San Diego, Feb. 2010

Carignan C, Tang J, Roderick S. "Development of an Exoskeleton Haptic Interface for Virtual Task Training." *Proc. IEEE/RSJ Int. Conf. on Intelligent Robots and Systems,* 3697-3702, St. Louis, Oct. 2009

Carignan C, Naylor M, Roderick S. "Controlling Shoulder Impedance in a Rehabilitation Arm Exoskeleton." *Proc. IEEE Int. Conf. on Robotics and Automation,* 2453-8, Pasadena, May 2008.

Carignan C, Tang J. "A Haptic Control Interface for a Motorized Exercise Machine." *Proc. IEEE Int. Conf. on Robotics and Automation,* 2055-60, Pasadena, May 2008.

Scott N**, Carignan C**. "A Line-Based Obstacle Avoidance Technique for Dexterous Manipulator Operations." *Proc. IEEE Int. Conf. on Robotics and Automation,* 3353-8, Pasadena, May 2008

Carignan C, Roderick S, Naylor M. "Distributed Control and Safety System for a Rehabilitation Arm Exoskeleton." *Proc. ASME Int. Mechanical Engineering Congress and Exposition (IMECE),* Seattle, Nov. 2007

Carignan C, Tang J, Roderick S, Naylor M. "A Configuration-Space Approach to Controlling a Rehabilitation Arm Exoskeleton." *Proc. Int. Conf. on Rehabilitation Robotics (ICORR),* Noordwijk, Netherlands, 179-187, June 2007

Tang J, Contreras-Vidal J-L, **Carignan C**. "Comparison of Neurosensorimotor Adaptation under Kinematic and Dynamic Distortions." *Proc. Int. Conf. on Rehabilitation Robotics (ICORR),* Noordwijk, Netherlands, 827-832, June 2007

Aksman L, Akin D, **Carignan C**. "Force Estimation Based Compliance Control of Harmonically Driven Manipulators." *Proc. IEEE Int. Conf. on Robotics and Automation,* Rome, 4208-4213, April 2007

Tang J, **Carignan C**, Olsson P. "Tandem Canoeing over the Internet using Haptic Feedback." *Proc. IEEE Virtual Reality Conf. (VR2006): 14th Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems,* Alexandria, 281-285, March 2006

Carignan C, Liszka M, Roderick S. "Design of an Exoskeleton with Scapula Motion for Shoulder Rehabilitation." *Proc. IEEE Int. Conf. on Advanced Robotics (ICAR)*, Seattle, 524-531, July 2005

Roderick S, **Carignan C**. "An Approach to Designing Software Safety Systems for Rehabilitation Robots." *Proc. Int. Conf. on Rehabilitation Robotics (ICORR),* Chicago, 252-257, June 2005

Tang J, **Carignan C**, Gattewar S. "Virtual Environment for Robotic Tele-Rehabilitation." *Proc. Int. Conf. on Rehabilitation Robotics (ICORR),* Chicago, 365-370, June 2005

Carignan C, Olsson P. "Cooperative Control of Virtual Objects over the Internet using Force-Reflecting Master Arms." *Proc. IEEE Int. Conf. on Robotics and Automation,* New Orleans, 1221-1226, April 2004

Carignan C, Howard R. "A Skew-Axis Design for a 4-Joint Revolute Wrist." *Proc. IEEE Int. Conf. on Robotics and Automation,* Washington, 3636-3642, May 2002

Lane JC, **Carignan C**, Sullivan B, Akin D, Hunt T, Cohen R. "Effects of Time Delay on Telerobotic Control of Neutral Buoyancy Vehicles." *Proc. IEEE Int. Conf. on Robotics and Automation,* Washington, 2874-2879, May 2002

Foster A, Akin D, **Carignan C**. "Development of a Four-Fingered Dexterous Robot End-Effector for Space Operations." *Proc. IEEE Int. Conf. on Robotics and Automation,* Washington, 2302-2308, May 2002

Carignan C, Lane JC, Akin D. "Controlling Robots On-Orbit." *Proc. of the IEEE International Symposium on Computational Intelligence in Robotics and Automation Conference,* Banff, Alberta, Canada, 314-319, July 2001

Carignan C, Akin D, Lane JC. "Dynamic Tool Vectors for Robo-Centric Control" *Proc. IEEE Int. Conf. on Robotics and Automation,* San Francisco, 1188-1193, Apr. 2000

Carignan C, Akin D. "Achieving Impedance Objectives in Robot Teleoperation" *Proc. IEEE Int. Conf. on Robotics and Automation,* Albuquerque, 3487-3492, Apr. 1997

Carignan C, Smith J. "Manipulator Impedance Accuracy in Position-Based Impedance Control Implementations." *Proc. IEEE Int. Conf. on Robotics and Automation,* San Diego, 1216-1221, May 1994

Carignan C. "Adaptive Tracking for Complex Systems using Reduced-Order Models." *Proc. IEEE Int. Conf. on Robotics and Automation,* Cincinnati, 2078-2083, May 1990

Carignan C, Akin D. "Tracking and Station Keeping for Free-Flying Robots using Sliding Surfaces." *Proc. IEEE Int. Conf. on Robotics and Automation,* Philadelphia, 969-974, Apr. 1988

Invited Conference Papers & Workshops:

J. Brannan, Scott N, **Carignan C**. "Robot Servicer Interacting with a Satellite During Capture." *Proc. Int. Symp. on Artificial Intelligence, Robotics and Automation in Space (i-SAIRAS),* Madrid, June 2018

Brannan J, **Carignan C**. "Interaction of a Robotic Servicing Vehicle with Satellite Flexible Modes during Capture." *Proc. AIAA Modeling and Simulation Technologies Conference,* Grapevine, Texas, Jan. 2017

Carignan C, Scott N, Roderick S. "Hardware-in-the-Loop Simulation of Satellite Capture on a Ground-Based Robotic Testbed." *Proc. Int. Symp. on Artificial Intelligence, Robotics and Automation in Space (i-SAIRAS),* Montreal, June 2014

Brannan J, **Carignan C**. "Modeling Flexible-Body Dynamics in Real-Time Robotic Systems used in Satellite Servicing Simulations." *Proc. AIAA Modeling and Simulation Technologies Conference,* Boston, Mass., Aug. 2013

Strube M, Hyslop A, **Carignan C**, Easley J. "Ground Simulation of an Autonomous Rendezvous and Tracking System using Dual Robotic Systems." *Proc. Int. Symp. on Artificial Intelligence, Robotics and Automation in Space (i-SAIRAS),* Turin, Italy, Sep. 2012

Dillow B, Akin D, **Carignan C**. "Development and Testing of a Dexterous Manipulation Capability for Autonomous Undersea Vehicles." *Proc. AIAA InfoTech@Aerospace Conference and Exhibit,* Seattle, Washington, April 2009

Lewandowski C, Akin D, Dillow B, Limparis N, **Carignan C**, Singh H, Sohn R. "Development of a Deep-Sea Robotic Manipulator for Autonomous Sampling and Retrieval." *Proc. IEEE/OES AUV2008 Conf. on Polar AUVs,* Woods Hole, Massachusetts, Oct. 2008

Akin D, **Carignan C**, Roderick S. "Autonomous Dexterous Sampling: From the Arctic Ocean to Mars and Beyond." *Proc. 11th Biennial ASCE Aerospace Division Int. Conf. on Engineering, Science, Construction, and Operations in Challenging Environments,* Long Beach, Calif., Sept. 2008

Sabelli E, Akin D, **Carignan C**. "Selecting Impedance Control Parameters for the Ranger 8-DOF Dexterous Space Manipulator." *Proc. AIAA InfoTech@Aerospace Conference and Exhibit,* Rohnert Park, California, May 2007

Olsson P, **Carignan C**, Tang J. "Cooperative Control of Virtual Objects using Haptic Teleoperation over the Internet." *Proc. Intl. Conf. on Disability, Virtual Reality and Associated Technologies,* pp. 149-156, Oxford, Sept. 2004

Carignan C, Olsson P, Tang J. "Robotic Rehabilitation over the Internet." *Proc. SPIE Int. Tech. Group Newsletter: Robots and Machine Perception 13(2),* Bellingham, WA, Sept. 2004

Gefke G, **Carignan C**, Roberts B, Lane JC. "Ranger Telerobotic Shuttle Experiment: Status Report." *Proc. SPIE Int. Symposium on Intelligent Systems and Manufacturing Proc. of SPIE Vol. 4570*: Telemanipulator and Telepresence Technologies VIII, 123-132, Newton, Mass., Oct. 2001

Lane JC, **Carignan C**, Akin D. "Time Delay and Communication Bandwidth Limitation on Telerobotic Control." *Mobile Robots XV and Telemanipulator and Telepresence Technologies VII, Proc. of SPIE Vol. 4195 (2001),* 405-419, Boston, Nov. 2000

Carignan C, Lane JC, Akin D. "Real-Time Simulation of a Free-Flying Robotic Vehicle." *Proc. AIAA Modeling and Simulation Technologies Conference,* 229-237, Portland, Aug. 1999

Cleary K, **Carignan C**, Traynor L. "Realistic Force Feedback for a Spine Biopsy Simulator." *Proc. International Workshop on Haptic Devices in Medical Applications,* Dillmann R, Salb T, Ed., 66-75, Paris, June 1999

Cleary K, Lathan C, **Carignan C**. "Simulator/Planner for CT-Directed Needle Biopsy of Spine." *Proc. of the SPIE, Vol. 3262: Minimally Invasive Instrumentation,* 218-224, San Jose, Jan. 1998

Carignan C, Akin D. "Actively Controlled Mockups for EVA Training in Neutral Buoyancy." *Proc. IEEE Int. Conf. on Systems, Man, and Cybernetics,* 2369-2374, Orlando, Oct. 1997

J. Corde Lane, **Carignan C**, Akin D. "Reconfigurable Control Station Design for Robotic Operations." *Proc. IEEE Int. Conf. on Systems, Man, and Cybernetics,* 3722-3727, Orlando, Oct. 1997

Carignan C, Tarrant J. "Constrained Trajectory Optimization for Kinematically Redundant Arms." *Proc. 3rd Int. Symposium on Robotics and Manufacturing,* ASME Press, 497-504, Burnaby, July 1990

Carignan C, Tarrant J, Mosier G. "An Adaptive Controller for Enhancing Operator Performance During Teleoperation." *Proc. IEEE Int. Conf. on Systems, Man, and Cybernetics,* Cambridge, Mass., 150-155, Nov. 1989

Carignan C, Tarrant J. "Impedance Hand Controllers for Increasing Efficiency in Teleoperations." *NASA Conf. on Space Telerobotics,* JPL Publication 89-7, Vol. III, 135-144, Pasadena, 1989

VanderVelde W, **Carignan C**. "Number and Placement of Control System Actuators Considering Possible Failures." *Proc. American Control Conference,* 7-15, Arlington, June 1982

Other Research-Related Journal Publications:

Delmonico M, Kostek M, Doldo N, Hand B, Walsh S, Conway J, **Carignan C**, Roth S, Bailey J, Hurley B: Alpha-Actinin-3 (ACTN3) R577X Polymorphism Influences Knee Extensor Peak Power Response to Strength Training in Older Men and Women, J. of Gerontology: Medical Sciences, Vol. 62A, No. 2, 206–212, 2007

Doldo N, Delmonico M, Bailey J, Hand B, Kostek M, Rabon-Stith K, Menon K, Conway J, **Carignan C**, Hurley B: Muscle-Power Quality: Does Sex or Race Affect Movement Velocity in Older Adults? J. of Aging and Physical Activity 14(4):411-422, Oct. 2006

Delmonico M, Kostek M, Doldo N, Hand B, Bailey J, Rabon-Stith K, Conway J, **Carignan C**, Lang J, Hurley B: Effects of moderate-velocity strength training on peak muscle power and movement velocity: do women respond differently than men? Journal of Applied Physiology 99: 1712-1718, July 2005

Delmonico M, Kostek M, Doldo N, Hand B, Bailey J, Rabon-Stith K, Conway J, **Carignan C**, Hurley B: Moderate velocity strength training increases peak muscle power in older women. Medicine and Science in Sports & Exercise 37 (5), May 2005

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