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สาขาวิทยาศาสตร์และเทคโนโลยี

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Title:	FEM-Based Generation of Stiffness Maps
Author:	Mekaouche, A. ; Chapelle, F. ; Balandraud, X.
Journal:	IEEE Transactions on Robotics, Volume 31, Issue 1, Feb. 2015, Pages: 217 - 222
Abstract:	In robotics, static stiffness maps are used as tools for the performance analysis of robots employed in production tasks, such as pick-and-place or manufacturing. This paper evaluates the relevance of a numerical tool built from a commercial finite element package to generate stiffness maps for any type of robot (serial, parallel, hybrid or compliant). The key points are the spatial resolution, the precision, and the calculation time of a stiffness map. The method for obtaining the 36 static stiffness maps of a 3-D robotic structure in its operational space is presented. The mechanical model is based on a finite element calculation using beam elements for the links and spring elements for the joints. The approach is first applied to a rigid-body mechanism. Numerical results show that a good compromise can be obtained between spatial resolution, precision, and calculation time. Then, the method is applied to a compliant structure requiring processing in a large displacement framework for the relevant estimation of a stiffness map. The numerical tool opens new prospects for the design of robotic structures, in terms of both optimization and use of various material behaviors.
Database:	IEEE/IET Electronic Library (IEL)

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Title:	Distributed Data Fusion for Multirobot Search
Author:	Hollinger, G.A. ; Yerramalli, S. ; Singh, S. ; Mitra, U. ; Sukhatme, G.S.
Journal:	IEEE Transactions on Robotics, Volume 31, Issue 1, Feb. 2015, Pages: 55 - 66
Abstract:	This paper presents novel data fusion methods that enable teams of vehicles to perform target search tasks without guaranteed communication. Techniques are introduced for merging estimates of a target's position from vehicles that regain contact after long periods of time, and a fully distributed team-planning algorithm is proposed, which utilizes limited shared information as it becomes available. The proposed data fusion techniques are shown to avoid overcounting information, which ensures that combining data from different vehicles will not decrease the performance of the search. Motivated by the underwater search domain, a realistic underwater acoustic communication channel is used to determine the probability of successful data transfer between two locations. The channel model is integrated into a simulation of multiple autonomous vehicles in both open water and harbor

		environments. The results demonstrate that the proposed distributed coordination techniques provide performance competitive with full communication.
	Database:	IEEE/IET Electronic Library (IEL)

3	Title:	Planar Path Following of 3-D Steering Scaled-Up Helical Microswimmers
	Author:	Xu, T. ; Hwang, G. ; Andreff, N. ; Regnier, S.
	Journal:	IEEE Transactions on Robotics, Volume 31, Issue 1, Feb. 2015, Pages: 117 - 127
	Abstract:	Helical microswimmers that are capable of propulsion at low Reynolds numbers have great potential for numerous applications. Several kinds of artificial magnetic-actuated helical microswimmers have been designed by researchers. However, they are primarily open-loop controlled. This paper aims to investigate methods of closed-loop control of a magnetic-actuated helical swimmer at low Reynolds number by using visual feedback. For many in-vitro applications, helical swimmers should pass through a defined path, for example along channels with no prerequisite on the velocity profile along the path. Therefore, the main objective of this paper is to achieve a velocity-independent planar path following task. Since the planar path following is based on 3-D steering control of the helical swimmer, a 3-D pose estimation of a helical swimmer is introduced based on the real-time visual tracking with a stereo vision system. The contribution of this paper is in two parts: The 3-D steering of a helical swimmer is demonstrated by visual servo control; and the path following of a straight line with visual servo control is achieved, then compared with open-loop control. We further expect that with this visual servo control method, the helical swimmers will be able to follow reference paths at the microscale.
	Database:	IEEE/IET Electronic Library (IEL)

4	Title:	BRVO: Predicting pedestrian trajectories using velocity-space reasoning
	Author:	Sujeong Kim, Stephen J. Guy, Wenxi Liu, David Wilkie, Rynson W.H. Lau, Ming C. Lin, and Dinesh Manocha
	Journal:	The International Journal of Robotics Research February 2015 34: 201-217
	Abstract:	We introduce a novel, online method to predict pedestrian trajectories using agent-based velocity-space reasoning for improved human–robot interaction and collision-free navigation. Our formulation uses velocity obstacles to model the trajectory of each moving pedestrian in a robot’s environment and improves the motion model by adaptively learning relevant parameters based on sensor data. The resulting motion model for each agent is computed using statistical inferencing techniques, including a combination of ensemble Kalman filters and a maximum-likelihood estimation algorithm. This allows a robot to learn individual motion parameters for every agent in the scene at interactive rates. We

		highlight the performance of our motion prediction method in real-world crowded scenarios, compare its performance with prior techniques, and demonstrate the improved accuracy of the predicted trajectories. We also adapt our approach for collision-free robot navigation among pedestrians based on noisy data and highlight the results in our simulator.
	Database:	Sage Journals Online

5	Title:	Tissue removal inside the beating heart using a robotically delivered metal MEMS tool
	Author:	Nikolay V. Vasilyev, Andrew H. Gosline, Arun Veeramani, Ming Ting Wu, Gregory P. Schmitz, Richard T. Chen, Veaceslav Arabagi, Pedro J. del Nido, and Pierre E. Dupont
	Journal:	The International Journal of Robotics Research February 2015 34: 236-247
	Abstract:	A novel robotic tool is proposed to enable the surgical removal of tissue from inside the beating heart. The tool is manufactured using a unique metal MEMS process that provides the means to fabricate fully assembled devices that incorporate micron-scale features in a millimeter scale tool. The tool is integrated with a steerable curved concentric tube robot that can enter the heart percutaneously through peripheral vessels. Incorporating both irrigation and aspiration, the tissue removal system is capable of extracting substantial amounts of tissue under teleoperated control by first morselizing it and then transporting the debris out of the heart through the lumen of the robot. Tool design and robotic integration are described, and ex vivo and in vivo large animal experimental results are presented.
	Database:	Sage Journals Online

6	Title:	Communication-aware information gathering with dynamic information flow
	Author:	Abdallah Kassir, Robert Fitch, and Salah Sukkarieh
	Journal:	The International Journal of Robotics Research February 2015 34: 173-200
	Abstract:	We are interested in the problem of how to improve estimation in multi-robot information gathering systems by actively controlling the rate of communication between robots. Communication is essential in such systems for decentralized data fusion and decision-making, but wireless networks impose capacity constraints that are frequently overlooked. In order to make efficient use of available capacity, it is necessary to consider a fundamental trade-off between communication cost, computation cost and information value. We introduce a new problem, dynamic information flow, that formalizes this trade-off in terms of decentralized constrained optimization. We propose algorithms that dynamically adjust the data rate of each communication link to maximize an information gain metric subject to constraints on communication and computation resources. The metric is balanced against the communication

	resources required to transmit data and the computation cost of processing sensor data to form observations. The optimization process selectively routes raw sensor data or processed observation data to zero, one or many robots. Our algorithms therefore allow large systems with many different types of sensors and computational resources to maximize information gain performance while satisfying realistic communication constraints. We also present experimental results with multiple ground robots and multiple sensor types that demonstrate the benefit of dynamic information flow in comparison to simpler bandwidth-limiting methods.
Database:	Sage Journals Online

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Title:	Stronger, Smarter, Softer: Next-Generation Wearable Robots
Author:	Asbeck, A.T. ; De Rossi, S.M.M. ; Galiana, I. ; Ye Ding ; Walsh, C.J.
Journal:	IEEE robotics & automation magazine, Dec. 2014, Volume:21 , Issue: 4, 22 - 33
Abstract:	Exosuits show much promise as a method for augmenting the body with lightweight, portable, and compliant wearable systems. We envision that such systems can be further refined so that they can be sufficiently low profile to fit under a wearer's existing clothing. Our focus is on creating an assistive device that provides a fraction of the nominal biological torques and does not provide external load transfer. In early work, we showed that the system can substantially maintain normal biomechanics and positively affect a wearer's metabolic rate. Many basic fundamental research and development challenges remain in actuator development, textile innovation, soft sensor development, human-machine interface (control), biomechanics, and physiology, which provides fertile ground for academic research in many disciplines. While we have focused on gait assistance thus far, numerous other applications are possible, including rehabilitation, upper body support, and assistance for other motions. We look forward to a future where wearable robots provide benefits for people across many areas of our society.
Database:	IEEE/IET Electronic Library (IEL)

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Title:	The Body Extender: A Full-Body Exoskeleton for the Transport and Handling of Heavy Loads
Author:	Fontana, M. ; Vertechy, R. ; Marcheschi, S. ; Salsedo, F. ; Bergamasco, M.
Journal:	IEEE robotics & automation magazine, Dec. 2014, Volume:21 , Issue: 4, 34 - 44
Abstract:	This article introduces and describes an electrically powered full-body (FB) exoskeleton, called the body extender (BE), intended as a research platform for the study of the transport and handling of heavy loads up to 50 kg, with one hand at worst-load conditions (WLCs). The machine features a 22-

		degrees-of-freedom (DoF) quasi-anthropomorphic kinematic scheme and a modular hardware/software architecture that made it possible to manage the complexity of the system design. Besides providing a context and some general guidelines, which have driven the design of the BE, this article presents the hardware and software developments that have been achieved and implemented in the machine. The experimental results are shown that prove the functionalities of the BE in common operating conditions such as walking, squatting, and handling loads. The one-of-a-kind system demonstrates, in relevant laboratory settings, the feasibility of a complex, electrically powered full-body exoskeleton with such a target payload.
	Database:	IEEE/IET Electronic Library (IEL)

9	Title:	An Architecture for Online Affordance-based Perception and Whole-body Planning
	Author:	Maurice Fallon, Scott Kuindersma, Sisir Karumanchi, Matthew Antone, Toby Schneider, Hongkai Dai, Claudia Pérez D'Arpino, Robin Deits, Matt DiCicco, Dehann Fourie, Twan Koolen, Pat Marion, Michael Posa, Andrés Valenzuela, Kuan-Ting Yu, Julie Shah, Karl Iagnemma, Russ Tedrake and Seth Teller
	Journal:	Journal of Field Robotics, Volume 32, Issue 2, pages 229–254, March 2015
	Abstract:	The DARPA Robotics Challenge Trials held in December 2013 provided a landmark demonstration of dexterous mobile robots executing a variety of tasks aided by a remote human operator using only data from the robot's sensor suite transmitted over a constrained, field-realistic communications link. We describe the design considerations, architecture, implementation, and performance of the software that Team MIT developed to command and control an Atlas humanoid robot. Our design emphasized human interaction with an efficient motion planner, where operators expressed desired robot actions in terms of affordances fit using perception and manipulated in a custom user interface. We highlight several important lessons we learned while developing our system on a highly compressed schedule.
	Database:	Wiley Online Library

10	Title:	Optimization-based Full Body Control for the DARPA Robotics Challenge
	Author:	Siyuan Feng, Eric Whitman, X. Xinjilefu and Christopher G. Atkeson
	Journal:	Journal of Field Robotics, Volume 32, Issue 2, pages 293–312, March 2015
	Abstract:	We describe our full body humanoid control approach developed for the simulation phase of the DARPA Robotics Challenge (DRC), as well as the modifications made for the DARPA Robotics Challenge Trials. We worked with the Boston Dynamics Atlas robot. Our approach was initially targeted at walking, and it consisted of two levels of optimization: a high-level trajectory optimizer that reasons

	about center of mass and swing foot trajectories, and a low-level controller that tracks those trajectories by solving floating base full body inverse dynamics using quadratic programming. This controller is capable of walking on rough terrain, and it also achieves long footsteps, fast walking speeds, and heel-strike and toe-off in simulation. During development of these and other whole body tasks on the physical robot, we introduced an additional optimization component in the low-level controller, namely an inverse kinematics controller. Modeling and torque measurement errors and hardware features of the Atlas robot led us to this three-part approach, which was applied to three tasks in the DRC Trials in December 2013.
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