

### **A tutorial on visual servo control**

Hutchinson, S.; Hager, G.D.; Corke, P.I.

Robotics and Automation, IEEE Transactions on, Vol.12, Iss.5, Oct 1996

Pages:651-670

Abstract: This article provides a tutorial introduction to visual servo control of robotic manipulators. Since the topic spans many disciplines our goal is limited to providing a basic conceptual framework. We begin by reviewing the prerequisite topics from robotics and computer vision, including a brief review of coordinate transformations, velocity representation, and a description of the geometric aspects of the image formation process. We then present a taxonomy of visual servo control systems. The two major classes of systems, position-based and image-based systems, are then discussed in detail. Since any visual servo system must be capable of tracking image features in a sequence of images, we also include an overview of feature-based and correlation-based methods for tracking. We conclude the tutorial with a number of observations on the current directions of the research field of visual servo control

URL: [http://www.ieeexplore.ieee.org/iel4/70/11632/00538972.pdf?isnumber=11632\[\]=STD&arnumber=538972&arnumber=538972&arSt=651&ared=670&arAuthor=Hutchinson%2C+S.%3B+Hager%2C+G.D.%3B+Corke%2C+P.I.](http://www.ieeexplore.ieee.org/iel4/70/11632/00538972.pdf?isnumber=11632[]=STD&arnumber=538972&arnumber=538972&arSt=651&ared=670&arAuthor=Hutchinson%2C+S.%3B+Hager%2C+G.D.%3B+Corke%2C+P.I.)

### **Control in robotics: open problems and future directions**

Siciliano, B.

Control Applications, 1998. Proceedings of the 1998 IEEE International Conference on, Vol.1, Iss., 1-4 Sep 1998

Pages:81-85 vol.1

Abstract: This paper focuses on the state-of-the-art of control problems in robotics. Beyond its tutorial value, the work aims at identifying challenging control problems that must be addressed to meet future needs and demands, as well as at indicating preliminary solutions to the identified problems. Various topics are covered starting from the closest issues related to industrial robotics, such as force control, multirobots and dexterous hands, to the most advanced issues related to underactuated and nonholonomic systems, as well as to teleoperation, haptic interfaces and visual servoing

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### **Advanced control techniques of robotic manipulators**

Ge, S.S.

American Control Conference, 1998. Proceedings of the 1998, Vol.4, Iss., 21-26 Jun 1998

Pages:2185-2199 vol.4

Abstract: In this tutorial, dynamic models of rigid body robots (RBRs), robots having motor dynamics (RMDs) and flexible joint robots (FJR), are first presented in the order of complexity. The controller design is then formulated in a unified fashion for these three kinds of robots because of their inherent similar physical and mathematical properties. After a brief review of basic control techniques being used, the controller design for RBRs is discussed in detail and a comprehensive list of passive parameter estimators and robust parameter estimators is given. Subsequently, the control problems for RMDs and FJR are treated in turns. While the two systems are different, it can be seen that they have very much similar properties, and accordingly can be analyzed similarly. It is shown that most of the existing popular controllers are special cases of the unified framework presented and

derivations and proofs can be simplified owing to the common background of the problems

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### **Adaptive motion control of rigid robots: a tutorial**

Ortega, R.; Spong, M.W.

Decision and Control, 1988., Proceedings of the 27th IEEE Conference on, Vol., Iss., 7-9 Dec 1988

Pages:1575-1584 vol.2

Abstract: An account is given of several adaptive control results for rigid robot manipulators. The intention is to lend some perspective to the growing list of adaptive control results for manipulators by providing a unified framework for comparison of those adaptive control algorithms which have been shown to be globally convergent. In most cases the authors are able to simplify the derivations and proofs of these results as well

URL: [http://www.ieeexplore.ieee.org/iel2/716/5019/00194594.pdf?isnumber=5019\[\]=STD&arnumber=194594&arnumber=194594&arSt=1575&ared=1584+vol.2&arAuthor=Ortega%2C+R.%3B+Spong%2C+M.W.](http://www.ieeexplore.ieee.org/iel2/716/5019/00194594.pdf?isnumber=5019[]=STD&arnumber=194594&arnumber=194594&arSt=1575&ared=1584+vol.2&arAuthor=Ortega%2C+R.%3B+Spong%2C+M.W.)

### **Autonomous vehicles**

Meyrowitz, A.L.; Blidberg, D.R.; Michelson, R.C.

Proceedings of the IEEE, Vol.84, Iss.8, Aug 1996

Pages:1147-1164

Abstract: There are various kinds of autonomous vehicles (AV's) which can operate with varying levels of autonomy. This paper is concerned with underwater, ground and aerial vehicles operating in a fully autonomous (nonteleoperated) mode. Further this paper deals with AV's as a special kind of device, rather than full-scale manned vehicles operating unmanned. The distinction is one in which the AV is likely to be designed for autonomous operation rather than being adapted for it as would be the case for manned vehicles. We provide a survey of the technological progress that has been made in AV's, the current research issues and approaches that are continuing that progress, and the applications which motivate this work. It should be noted that issues of control are pervasive regardless of the kind of AV being considered, but that there are special considerations in the design and operation of AV's depending on whether the focus is on vehicles underwater on the ground, or in the air. We have separated the discussion into sections treating each of these categories

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### **Algorithmic motion planning in robotics**

Sharir, M.

Computer, Vol.22, Iss.3, Mar 1989

Pages:9-19

Abstract: A survey is presented of an approach to motion planning that emphasizes object-oriented, exact, and discrete (or combinatorial) algorithmic techniques in which worst-case asymptotically efficient solutions are being sought. Following a statement of the problem, motion planning in static and known environments is treated. The discussion covers general solutions, lower bounds, the projection

method, the retraction method, the expanded obstacles, the single-component approach, and a mobile convex object moving in a 2D polygonal space. Variants of the motion-planning problem are then considered, namely, optimal motion planning, adaptive and exploratory motion planning, motion planning in the presence of moving obstacles, constrained motion planning, motion planning with uncertainty, and general task planning

URL: [http://www.ieeexplore.ieee.org/iel1/2/580/00016221.pdf?isnumber=580\[\]=JNL&arnumber=16221&arnumber=16221&arSt=9&ared=19&arAuthor=Sharir%2C+M.](http://www.ieeexplore.ieee.org/iel1/2/580/00016221.pdf?isnumber=580[]=JNL&arnumber=16221&arnumber=16221&arSt=9&ared=19&arAuthor=Sharir%2C+M.)

### **Survey of robust control for rigid robots**

Abdallah, C.; Dawson, D.M.; Dorato, P.; Jamshidi, M.  
Control Systems Magazine, IEEE, Vol.11, Iss.2, Feb 1991  
Pages:24-30

Abstract: Current approaches to the robust control of the motion of rigid robots are surveyed, and the available literature is summarized. The five major design approaches discussed are the linear-multivariable approach, the passivity approach, the variable-structure approach, the saturation approach, and the robust-adaptive approach. Some guidelines for choosing a method are offered

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### **A survey of robot interaction control schemes with experimental comparison**

Chiaverini, S.; Siciliano, B.; Villani, L.  
Mechatronics, IEEE/ASME Transactions on, Vol.4, Iss.3, Sep 1999  
Pages:273-285

Abstract: A great many control schemes for a robot manipulator interacting with the environment have been developed in the literature. This paper is aimed at presenting a survey of robot interaction control schemes for a manipulator, the end effector of which comes in contact with a compliant surface. A salient feature of the work is the implementation of the schemes on an industrial robot with open control architecture equipped with a wrist force sensor. Two classes of control strategies are considered, namely, those based on static model-based compensation and those based on dynamic model-based compensation. The former provide a good steady-state behavior, while the latter enhance the behavior during the transient. The performance of the various schemes is compared in the light of disturbance rejection, and a thorough analysis is developed by means of a number of case studies

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### **Fault Diagnosis and Fault Tolerant Control for Wheeled Mobile Robots under Unknown Environments: A Survey**

Duan Zhuo-hua; Cai Zi-xing; Yu Jin-xia  
Robotics and Automation, 2005. ICRA 2005. Proceedings of the 2005 IEEE International Conference on, Vol., Iss., 18-22 April 2005  
Pages: 3428- 3433

Abstract: Fault detection and diagnosis (FDD) and fault tolerant control (FTC) are increasingly important for wheeled mobile robots (WMRs), especially those in unknown environments such as planetary exploration. Due to the importance of reliability and safe operation of WMRs, this paper presents a survey of state-of-the-

art in FDD & FTC of WMRs under unknown environments. Firstly, we briefly introduce main components, typical kinematics models and fault models of WMRs and error models of inertial navigation sensors. Secondly, we discuss main approaches for FDD/FTC of WMRs, including multiple model based approach, particle filter based approach, sensor fusion based approach, layered fault tolerant architecture and so on. At last, the main challenges, difficulties and some future trends for the field are offered.

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### **A survey of consensus problems in multi-agent coordination**

Wei Ren; Beard, R.W.; Atkins, E.M.

American Control Conference, 2005. Proceedings of the 2005, Vol., Iss., 8-10 June 2005

Pages: 1859- 1864 vol. 3

Abstract: As a distributed solution to multi-agent coordination, consensus or agreement problems have been studied extensively in the literature. This paper provides a survey of consensus problems in multi-agent cooperative control with the goal of promoting research in this area. Theoretical results regarding consensus seeking under both time-invariant and dynamically changing information exchange topologies are summarized. Applications of consensus protocols to multiagent coordination are investigated. Future research directions and open problems are also proposed.

URL: [http://www.ieeexplore.ieee.org/iel5/9861/31519/01470239.pdf?isnumber=31519\[\]=STD&arnumber=1470239&arnumber=1470239&arSt=+1859&ared=+1864+vol.+3&arAuthor=Wei+Ren%3B+Beard%2C+R.W.%3B+Atkins%2C+E.M.](http://www.ieeexplore.ieee.org/iel5/9861/31519/01470239.pdf?isnumber=31519[]=STD&arnumber=1470239&arnumber=1470239&arSt=+1859&ared=+1864+vol.+3&arAuthor=Wei+Ren%3B+Beard%2C+R.W.%3B+Atkins%2C+E.M.)

### **A survey of repetitive control**

Li Cuiyan; Zhang Dongchun; Zhuang Xianyi

Intelligent Robots and Systems, 2004. (IROS 2004). Proceedings. 2004 IEEE/RSJ International Conference on, Vol.2, Iss., 28 Sept.-2 Oct. 2004

Pages: 1160- 1166 vol.2

Abstract: Repetitive control method is well known for its high performances in feedback systems that are subject to periodic exogenous inputs. This paper reviews the theory and applications of repetitive control based on both the internal model and external model, together with some repetitive control methods for nonlinear plants.

URL: [http://www.ieeexplore.ieee.org/iel5/9577/30276/01389553.pdf?isnumber=30276\[\]=STD&arnumber=1389553&arnumber=1389553&arSt=+1160&ared=+1166+vol.2&arAuthor=Li+Cuiyan%3B+Zhang+Dongchun%3B+Zhuang+Xianyi](http://www.ieeexplore.ieee.org/iel5/9577/30276/01389553.pdf?isnumber=30276[]=STD&arnumber=1389553&arnumber=1389553&arSt=+1160&ared=+1166+vol.2&arAuthor=Li+Cuiyan%3B+Zhang+Dongchun%3B+Zhuang+Xianyi)

### **A taxonomy for robot control**

Miljanovic, D.M.; Croft, E.A.

Robotics and Automation, 1999. Proceedings. 1999 IEEE International Conference on, Vol.1, Iss., 1999

Pages:176-181 vol.1

Abstract: In this work, a limited survey of the diverse issues related to robot control design architectures is presented. Based on this review, an initiatory taxonomy of robot control tasks, motions, architectures, and controllers is proposed. The objective for this taxonomy is to develop an expert system for industrial robot

control under the emerging open architecture controller paradigm

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