

Application Form / Workshop Description

Session Title:

Wire-driven parallel robots

Organizers

- Tobias BRUCKMANN, Duisburg-Essen University, email: bruckmann@mechatronik.uni-duisburg.de
- Jean-Pierre MERLET, INRIA Sophia-Antipolis, email: Jean-Pierre.Merlet@inria.fr
- Andreas POTT, Fraunhofer IPA, email: Andreas.Pott@ipa.fraunhofer.de

Motivation and objective, Approach

The drawback of classical parallel robot is mainly their limited workspace, which is due to the limitation of the stroke of linear actuator and of the passive joint motion, singularity (i.e. the poses in which the forces in the leg may go to infinity) and legs interference. In a wire-driven parallel robot, the linear actuators are replaced by wires whose lengths can be adjusted as in the SEGESTA robot from University of Duisburg-Essen.

Although these robots share the basic concepts of classical parallel robot they feature some major differences:

- the flexibility of wire allows larger changes in the length of the chain, for example by coiling the wire on a drum. This allows overcoming one workspace limitation factor of classical robot.
- wire coiling can be performed with fast actuators while the moving mass of the robot is extremely low, thus allowing the robot to reach very high speed
- the flexibility of wire allows avoiding the use of complex kinematic passive joints such as the U and S joints used in a Gough platform
- a wire admits only unilateral constraint, i.e. a wire can pull but cannot push. A direct consequence is that to ensure positive tension in the wires of an n-dof robot it is necessary to have at least n+1 wires (or to use gravity as a virtual wire: for example wire crane can use only 6 wires). Having a large number of wires leads to redundant robot that allow for singularity avoidance, optimal distribution of the load among the wires and calibration



In the last five years there has been a renewal of interest for wire-driven parallel robots for two main reasons:

- a large number of potential applications has appeared not only for industry (e.g. fine manipulation of heavy and bulky material, maintenance of large devices) but also for medicine (rehabilitation and training) and assistance robotics (walking aid, patient transfer). Each of them needs to address specific issues such as safety, adaptability, power management . . .

Application Form / Workshop Description



- from a theoretical viewpoint it has appeared that there was many unsolved issues regarding kinematics, dynamics, design and redundancy management that need to be addressed before moving to applications

The purpose of this workshop is to propose a state of the art on potential applications, existing prototypes and theoretical open issues.

The proposed speakers have built several prototypes of wire-driven parallel robots for various industrial and medical projects and are involved in Cablebot European project (Parallel Cable Robotics for Improving Maintenance and Logistics of Large-Scale Products) that has started at the end of 2011. The proposed talks will mix practical implementation and use, lessons learned from this corpus of experiments and issues that must be addressed.

Speakers

- T. Bruckmann, Application Examples of Wire Robots
- A. Pott
- J-P. Merlet, Open issues in the theory for wire-driven parallel robots
- M. Cecarelli, to be confirmed

Participants and Agenda

Participants must have a basic knowledge of the structure of parallel robots (the workshop web page will provide the necessary links for that purpose). We propose to have two open panel sessions for participants:

industrial/application session: a 10mn slot will be allotted to present potential innovative applications in which wire-driven parallel robots may play a role. After each presented application a 10mn discussion will be held to discuss the advantages and drawbacks of using such robot for that particular case
academic session: a 10mn slot will be allotted to present prototypes or specific theoretical issues that have not been addressed by the speakers

Hence the proposed agenda is:

- 14h00 - 14h10: introduction to the workshop
- 14h10 - 14h30: speaker 1
- 14h30 - 14h50: speaker 2
- 14h50 - 15h10: speaker 3
- 15h10 - 15h30: speaker 4
- 15h30 - 16h: industrial/application session
- 16h00 - 16h30: academic session

Further information

Information on the workshop will be posted on the workshop web <http://www-sop.inria.fr/members/Jean-Pierre.Merle> together with useful links to parallel robots.

Follow-up

The presentations of the speakers will be freely available on the workshop web site. The discussions that will be held during the industrial/application and academic sessions will be summarized in a prospective report that will be made available on the EUROP and EURON websites. A conference on this subject will be organized in September 2012

Application Form / Workshop Description



S

Organiser(s):

- Knud Aulkær Andersen, Mech. Eng. B.Sc., Project Manager at Danish Technological Institute (DTI), Centre for Robot Technology, Forskerparken 10, 5230 Odense M, Denmark. Email: kaa@dti.dk, phone: +45 72 20 21 54
EURON and EUROP member

Motivation and objective:

The focus of the workshop is on the challenges met during detection and handling of flexible objects, including estimation of the nonlinear object model, pose estimation of the object(s), as well as how to handle and predict deformations in a robotic system.

The aim is to clarify the possibilities in future robotics platforms for handling flexible objects, which will open for future possible tasks to be solved by robots in the industry. The long term goal, sought by enabling handling flexible objects, is to generate more workplaces and better work environment in the industry – keeping workplaces in Europe.

Approach:

The workshop will be a series of presentations (3 – 5), with focus on different aspects of the entire process of handling flexible object, concluded with a Round Table discussion. The various presentations are dependent on the final accept by the invited speakers.

Agenda of the workshop:

- 10 Min - Overview of Intelligent Robots for Manipulation of flexible objects
By Knud Aulkær Andersen

Application Form / Workshop Description

- 30 Min - Vision system for extraction real-time 3D object information
By Prof. Dr.-Ing. Reinhard Koch and Andreas Jordt
- 30 Min - Simulation of internal forces in deformable objects
By Prof. Morten Willatzen & Andreas Rune Fugl – Not confirmed
- 30 Min - Robotic grasping and handling of deformable objects
By Prof. Norbert Krüger, Prof. Henrik Gordon Petersen & Leon Bodenhausen
- 30 Min - Round Table Discussion 30 min

Invited speaker(s):

- Knud Aulkær Andersen, Project Manager
Danish Technological Institute
Centre for Robot Technology
- Prof. Dr.-Ing. Reinhard Koch & Andreas Jordt
Christian-Albrechts-Universität zu Kiel
Institut für Informatik
- Prof. Norbert Krüger, Prof. Henrik Gordon Petersen & Leon Bodenhausen
University of Southern Denmark
Maersk Moller Institute
Prof. Henrik Gordon Petersen is currently not confirmed
- Prof. Morten Willatzen & Andreas Rune Fugl
University of Southern Denmark
Mads Clausen Institute
Not confirmed

How can participants contribute to, and prepare for, the workshop?

Visiting the website mentioned in “Further information” will provide the attendants with an introduction to the technology and the approach presented by the speakers. The attendants are encouraged to bring forward possibly application cases of the technology at the workshop for the Round Table discussion. Additionally we encourage that the demonstrator “Intelligent Robots for Handling of Flexible Objects” at display is visited before the workshop

Further information:

Visiting the website www.interreg-robot.eu which contains articles, videos and other scientific work within the area of the workshop, will help clarify the problems investigated by speakers and gives a more detailed overview to flexible object handling.

A demonstrator from an actual project which bundles various parts of the above technology will be on display at the Forum. The technologies such as vision, modelling and grasping together with handling of flexible objects can be investigated in a real application. The demonstrator intends to show state-of-the-art for such technologies, and will in the future be transferred to system integrators working on high-level robotic platforms.

Planned follow-up:

The outcome of the workshop can be strengthened by collecting information about the industrial need for handling of flexible objects and in which business areas this could be applied. This information will be made available to attendants of the workshop.