

Six Days Course on

Kinematics and Design of Parallel Manipulators

For Practicing Engineers and Research Beginners

6^h to 11^h December 2017



Discipline of Mechanical Engineering
Indian Institute of Technology Indore
Indore, Madhya Pradesh, India
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Course Contents

Introduction to Parallel Manipulators

Kinematics of Planar Parallel Manipulators

2T parallel manipulators

2T1R parallel manipulators

Kinematics of Spatial Parallel Manipulators

3T parallel manipulators

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3T1R parallel manipulators

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3T3R parallel manipulators

Main Architectures

Inverse and Direct Kinematics

Singularities

Kinematic Design Issues

Case Studies

Examination and Certificate

An examination will be conducted at the end of the course and grade sheets as well as participation certificate will be give to all the participants.

Important Dates

Last date for Registration : November 25, 2017

Course schedule : December 6-11, 2017

Course Overview

Parallel manipulators are made up of several kinematic chains that link a base to a moving platform. Famous examples are the Gough-Stewart platform used in flight simulators and the Delta robot used for fast pick-and-place tasks. They may offer interesting features such as higher stiffness and higher dynamics as compared to serial manipulators. On the other hand, the kinematics of parallel manipulators is generally more challenging. In particular, the mobility analysis, the input/output equations and the singularities are difficult to establish. Accordingly, the kinematic design of parallel manipulators is also very challenging. This lecture course covers the most useful kinematic concepts of parallel manipulators in view of their optimal kinematic design.

Course Objectives

The lecture course addresses students of undergraduate and graduate level (MTech, PhD students) as well as faculty teaching mechanical system topics who want to get more familiar with the kinematics and design of parallel manipulators.

The objectives of the course are:

- The students have a deep knowledge of the kinematics of parallel manipulators;
- The students are able to model and analyze the above-mentioned parallel manipulators;
- The students are able to derive the constraint equations and the forward/inverse kinematic models of usual parallel manipulators;
- The students are able to identify and interpret the singularities of usual parallel manipulators;
- The students know the basic performance indices for the evaluation of parallel manipulators and are aware of the advantages and limits of these indices;
- The students learn basic design rules for the synthesis of parallel manipulator architectures for prescribed motions;
- The students learn on how set an optimization problem to design a parallel manipulator.

Teaching Faculty



Philippe Wenger: After completing his master degree in Robotics at Ecole Nationale Supérieure de Mécanique de Nantes in 1985, he completed a PhD in Robotics at the Ecole Centrale de Nantes - University of Nantes in 1989. From 1989 to 1990, he worked as an Assistant Professor in Mechanical Engineering and Robotics at Ecole Centrale de Nantes. Philippe Wenger worked as a full-time researcher at the Centre National de la Recherche Scientifique (CNRS) since 1990 and took the position of a CNRS Director of Researcher and became a full professor in 2000. He was headed various research teams of Institut de Recherche en Communications et Cybernétique de Nantes (IRCCyN).

Her Current Research interest includes:

- Kinematics and performance analysis of robots
- Singularity analysis and Design of serial and parallel manipulators
- Tensegrity mechanisms
- Trajectory optimization
- CAD-Robotics

He has published 56 papers in peer-reviewed international journals, 2 patents, Editor in Chief of 3 books, 21 book chapters, 146 papers in international conferences, 26 keynotes or plenary lectures in national and international conferences, workshops and seminars. He has supervised 20 PhD students and 57 Master students (since 1991). He is holding Associate Editor positions for Mechanism and Machine Theory (since 2009-till date), ASME Journal of Mechanisms and Robotics (since 2012) and Problems of Mechanics (2004-2008).

His ongoing Sponsored Projects:

- PIA Equipex Robotex, Robotic Platforms (962k€)
- ANR KAPAMAT, Singularities of lower-mobility parallel manipulators (220k€)
- ANR AVINECK, Design of a robotic arm inspired from the bird neck (352k€)

Course Coordinator



Santhakumar Mohan: After completing his master degree in Manufacturing Engineering at the Government College of Technology, Coimbatore in 2005, he completed a PhD in Robotics and Control at the Indian Institute of Technology Madras, Chennai in 2010. From June 2010 to March 2011, he worked as an assistant professor in the Department of Mechanical Engineering at National Institute of Technology Calicut (NITC), Kerala (India). He then worked as world-class university (WCU) postdoctoral fellow at Korean Advanced Institute of Science and Technology (KAIST), Daejeon (Republic of Korea), in addition to this, he received another prestigious Brain Korea 21 (BK21) Post-doctoral fellowship with the same institute from September 2011 to March 2012. In 2012, he joined the faculty of the Mechanical Engineering at Indian Institute of Technology Indore. Currently, he is the head, Centre for Robotics and Control, IIT Indore. He is holding visiting faculty positions at IISc Bangalore, India, RWTH Aachen, Germany and ECN, France.

His active research areas include underwater vehicle control, underwater manipulator design and control, assistive and rehabilitation robots, design and control of mobile manipulators and parallel robotic platforms.

He has received the outstanding young Scientist for the year 2014 from Korea Robotics Society and Alexander von Humboldt Fellowship (2016–2017). He has published more than 100 articles in various journals and conference proceedings. He has 2 Indian patents in parallel robots and lower limb rehabilitation mechanisms.

Who can attend?

- Undergraduates, MTech/M.Sc, and PhD science stream students. Any student with a basic background in robotics/mechanism science will be able to follow these lectures and gain valuable information.
- BTech/B.Sc and MTech/M.Sc level teachers who wish to update their knowledge in an important special field of robotic kinematics and design.
- Executives, engineers and researchers from industry, service and government organizations including R&D laboratories who are engaged in robotics or mechanism kinematics related problems.

Registration Fee

Students (UG & PG)	: Rs. 3,000
Research Scholars	: Rs. 4,000
Faculty members	: Rs. 5,000
Industry and others	: Rs. 10,000
Foreigners (any positions)	: USD 250

Travel Information

Indore located in Central part of India in Madhya Pradesh State. It will well-connected by rail, road and air. The nearest railway station is Indore Junction and the nearest Airport is Devi Ahilyabai Holkar Airport. For queries regarding travel information, please contact the course coordinator.

Accommodation

Paid accommodation will be provided to participants on first-come-first-serve basis.

Course fee includes course material, tutorial sheets, lecture handouts, lunch and tea during course days

Contact Details

For any information regarding eligibility, fee payment, travel information, accommodation, etc., please contact the course coordinator via email or phone.

Dr. Santhakumar Mohan

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Link for registration: <http://gian.iiti.ac.in/register.php>

Please email the application form along with the proof of the registration fee payment to the course coordinator.

Fee payment details can be found at: <http://gian.iiti.ac.in/>