

## Program

Friday 19/06	Cable-Driven // Robots Plenary Lecture Speaker : <b>T. Bruckmann</b>	Coffee break	Biomechanics Plenary Lecture Speaker : <b>N. Sanclisi</b>	Lunch	Simulation lab Project	Coffee break	Simulation lab Project
Thursday 18/06	Cable-Driven // Robots Plenary Lecture Speaker: <b>M. Gouttefarde</b>	Coffee break	Humanoids & PKMs Plenary Lecture Speaker : <b>A. Parnigiani</b>	Lunch	Industrial issues Plenary Lecture Speaker : <b>SYMETRIE</b>	Coffee break	Simulation lab Project
Wednesday 17/06	Cable-Driven // Robots Plenary Lecture Speaker : <b>A. Chemori</b>	Coffee break	Haptics & Rehabilitation Plenary Lecture Speaker : <b>A. Frisoli</b>	Lunch	<b>Social Event</b>	Coffee break	Project
Tuesday 16/06	Plenary Lecture Speaker : <b>J. P. Merlet</b>	Coffee break	Plenary Lecture Speaker : <b>O. Company</b>	Lunch	Grasping Plenary Lecture Speaker : <b>J. Borras</b>	Coffee break	Simulation lab Project
Monday 15/06	Kinematics & statics Plenary Lecture Speaker : <b>M. Carricato</b>	Coffee break	Kinematics & singularity Plenary Lecture Speaker : <b>S. Caro</b>	Lunch	Dynamics Plenary Lecture Speaker : <b>S. Briot</b>	Coffee break	Simulation lab Project
	9:00 – 10:30 (1h30)	10:30 – 11:00	11:00-12:30 (1h30)	12:30 – 14:30	14:30 – 16:00 (1h30)	16:00 – 16:30	16:30 – 18:00 (1h30)

## Admission

The number of participants is restricted to 45. Priority will be given to Ph.D. students and Post-docs from the European Community. But a significant number of researchers and professionals, as well as students from other countries may also be accepted.

The registration includes two steps. A preregistration is required before the 31<sup>st</sup> of January 2020, where a scientific committee will select the candidates based on their CVs. Accepted participants should proceed to final registration by March 31<sup>st</sup>, 2020 on:

<http://www.lirmm.fr/pkm-2020/registration/>

Meal expenses (including lunches and coffee breaks) will be supported by the organizers thanks to sponsor funding and participants registration fees. Participants must cover their own travel and logging expenses.



## Contact

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## Sponsorship



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**LIRMM**

## 3<sup>rd</sup> Summer School On Parallel Kinematic Manipulators PKM 2020

June 15-19, 2020  
Bologna (Italy)

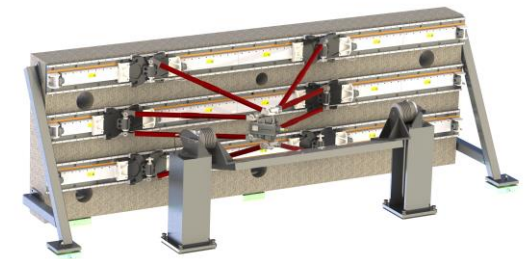


Image: ARROW PKM ©: LIRMM

Coordinated by  
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Bologna, Italy  
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Montpellier, France

[www.lirmm.fr/pkm-2020](http://www.lirmm.fr/pkm-2020)

## Parallel Kinematic Machines

Robotics community have devoted a huge research effort on parallel kinematics machines in the past four decades. The interest was motivated by a clear breakthrough compared to conventional serial robot architectures, such as anthropomorphic, SCARA or gantry robots. Parallel kinematics systems have demonstrated higher performances in:

- dynamic capabilities in terms of high accelerations (up to 1000 m/s<sup>2</sup> accelerations have been reached by prototypes, pushing the limits of mechanics, control and actuators),
- high payloads, where hexapods can lift today several tons and position them accurately with six degrees of freedom,
- increased stiffness.

The scientific community has addressed many research topics. Kinematics, dynamics, singularities, uncertainties, type and dimensional synthesis, control, simulation, calibration, identification, mechanical design, technology, performance indices, reconfigurable devices, and experiments.

A good control of these issues is requested to obtain a convincing running prototype, with potential applications in industry.

As a short list of products that have reached the industrial market, one can mention:

- Hexapods or hexapod-like robots (also known as Gough, Stewart or Gough-Stewart platforms). Among them we can mention some products by PI, Symétrie and or Fanuc,
- Delta or Delta-inspired robots, originally licensed to ABB (Flexpicker), whose patent has entered the public domain, so that this kind of robot is now available from several manufacturers (Fanuc, Codian Robotics, SIG Pack Systems, Panasonic...),
- Tricept (Neos Robotics) and Exechon (Exechon AB),
- Quattro, Hornet (Adept).

Despite the huge research effort devoted to this domain, only a few products are available on the market. The main explanations lie, on the one hand, in the fact that such robots can seem complex and require significant research investigation, on the other hand in the consideration that academic research is split into specialized domains. Moreover, when prototypes or demonstrators are built, the goal is usually to validate theories through experiments, rather than to convince industrial partners for future products or applications. Nevertheless, some demonstrators meet industrial applications.

On a research point of view, theory has to face technological limitations in terms of:

- industrial control systems,
- active and passive joints integration,
- collision avoidance.

The goal of PKM 2020 is to share the knowledge on parallel kinematic machines design, modelling and control during a whole week, targeting realistic prototypes to face real problems met by industry.

The courses are divided in plenary lectures and simulation labs. They are addressed to PhD students, post-docs and researchers already involved in the area or interested in parallel kinematic machines. Basic background in mechanical, computer science, control and electrical engineering is recommended.

## Content

Different session formats will be planned:

- plenary lectures by invited international speakers,
- plenary lectures by local speakers and industrials,
- project sessions with simulation labs.

The topics tackled during the sessions include:

- Kinematics,
- Dynamics,
- Design,
- Grasping, haptics and rehabilitation,
- Control,
- Simulation (with Matlab/Adams coupling),
- Special sessions on cable driven parallel robots.

## Invited lecturers

Chosen among the most well-known experts worldwide, the lecturers have a significant theoretical and practical background in PKM community:

**Júlia Borràs**, Polytechnic University of Catalonia, Spain  
**Tobias Bruckmann**, University Duisburg-Essen, Germany  
**Andreas Müller**, Johannes Kepler University Linz, Austria  
**Antonio Frisoli**, Scuola Superiore Sant'Anna, Italy  
**Alberto Parmiggiani**, IIT, Italy  
**Nicola Sancisi**, University of Bologna, Italy  
**Marco Carricato**, University of Bologna, Italy  
**Jean-Pierre Merlet**, INRIA, France  
**Stéphane Caro**, LS2N, CNRS, France  
**Ahmed Chemori, Olivier Company, Marc Gouttefarde**, LIRMM, UM/CNRS, France

## Lectures and school materials

All lectures will be given in English. The lecturers' slides will be available online at class time. *The students are advised to bring their own laptop with a running Matlab version and a "student version" of ADAMS software.*

## Scientific committee

**Olivier Company**, LIRMM, UM/CNRS, France  
**Marc Gouttefarde**, LIRMM, UM/CNRS, France  
**Sébastien Krut**, LIRMM, UM/CNRS, France  
**Ahmed Chemori**, LIRMM, UM/CNRS, France  
**Stéphane Caro**, LS2N, CNRS, France  
**Sébastien Briot**, LS2N, CNRS, France

## Venue & Accommodation

All the lectures will be given at the School of Engineering, University of Bologna, Viale Risorgimento 2, Bologna, Italy  
<http://www.lirmm.fr/pkm-2020/venue/>

The participants may find some suggestions for accommodation on the website of the school at:  
<http://www.lirmm.fr/pkm-2020/>

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