

# WORKSHOP SUMMARY

- 1) Industrial Panel (4 slides)**
- 2) Educational Panel (3 slides)**
- 3) Overall Comments (6 slides)**

# Industrial Panel: 3 October, 2002

- There is potential for cable systems, especially those with better sensors, fuzzy logic controllers. There is scope for generic (modular) designs to aid in developments.
- Parallel devices exist now for providing displacements in the micro- and nano-meter ranges. There is potential that parallel devices will replace serial devices in these applications.

- There is a need for better designs of motors and sensors that can give higher-fidelity control of large parallel devices.
- In parallel robotic machine tools, stiffness and accuracy can be achieved simultaneously. It is important to preload bearings in the joints and to sense the position of the tool directly, rather than sense internally to the drive.
- New parallel devices that contain design faults, such as singularities, yet appear on the market and in the literature. This comment leads to the suggestions that there should be greater interaction between industry and academics with interests and qualifications regarding PKM's.

# Most important needs

- Better metrology, then use compensation.
- More careful examination of the kinematic structure early in a design, perhaps through an expert system that matches kinematic structure to application.
- Better match the characteristics of the PKM to those of the application: kinematic design, accuracy of control, software correction.
- Collaborations (industry – academia, control – mechanical design).
- Better motor-gearbox designs (less noise).
- Lower-cost systems.

# Open Question

- How do we get more collaboration between industry and academia?

# EduPanel: 1. Inventory

- Design, simulation, prototyping (Alba)
- \$200 3RRR prototypes (Imme)
- 1-year senior design project (John)
- Laval Lab (Clement)

# EduPanel 2: Ideal situation

- Undergrad courses: inspired by application. Graduate courses more theoretical (Students)
- No exciting but useless devices (Dimiter)
- Prototypes to experience phenomena (Imme), otherwise not convincing (Alba)
- Motivation by examples (Jean-Pierre)
- Self-developing takes innovation load from instructor, not only PKM (Jorge)
- Not too practical: basic proficiency (Torgny)

# EduPanel 3: Plan de Campagne

- Use of simulation tools and rapid prototyping facilities; Combine “German way” (applied) and “American way” (academic). (Jean Pierre)
- No double work in creating software (Jean Pierre)
- Library of educational activities (Venkat)

# Collected Overall comments

- PM research *must* be **application-driven** in order to be successful
- Do not overstate claims for PMs:  
Ex: rigidity, stiffness, accuracy  
Success will be measured against claims
- Claims must be based on reality taking *all* aspects into account...

# Collected Overall Comments

Performance measures are still a central topic:

- What measures should be used?
- How should they be evaluated?
- Be careful when evaluating measure numerically – need to know error bounds
- What do numbers really mean?
- How do we compare different PKs?
- How do we take controls into account?

# Overall Comments – cont'd

Are our definitions even clear?

- Ex.: What do we mean by stiffness?

What does *industry* mean by stiffness (direction of least stiffness for given pose)?

Is isotropy always meant to be in joint space or end-effector space? What is the physical meaning?

What do we mean by reconfigurability?

→ Should community agree on and post definitions?

# Questions

- Are we asking the right questions?
- Is isotropy that important for industry?
- What should be the weighting of the questions? E.g. modes are important, but not at the cost of workspace, etc.
- Again – How do application requirements translate into design specifications?

# Suggestions

- Central database should be extended and used more!  
software, teaching aids, vocabulary, discussions?
- Would a central (electronic) discussion forum be a good idea?

# Some More Needs

- Efficient Calibration Routines
- Metrology
- Effect of Clearances
- Over-constrained mechanisms: control issues

# What did we miss?

SEND YOUR COMMENTS TO

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to be included in final summary report.

THANKS FOR COMING!!!