Modeling, Analysis and Control of a Class of Elastically Joints-actuated Multibody Systems

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TIPS TO BE CONVERED

- **INTRODUCTION**
- **CASE STUDY**
- **APPLICATIONS**
- **CHALLENGES**
- **FUTURE WORKS**
- **REFERENCE**

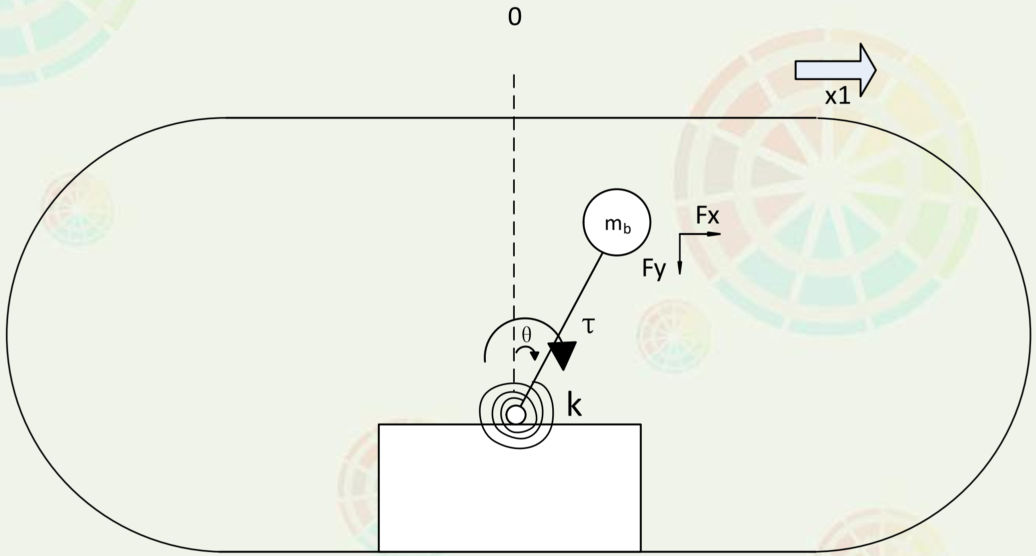
INTRODUCTION

- Ideals
  - ➢ Software control
  - ➢ Rigid transmissions
  & minimizing compliance

- Reality
  - ➢ Impacts
  - ➢ Kinetic energy transfer

CASE STUDY

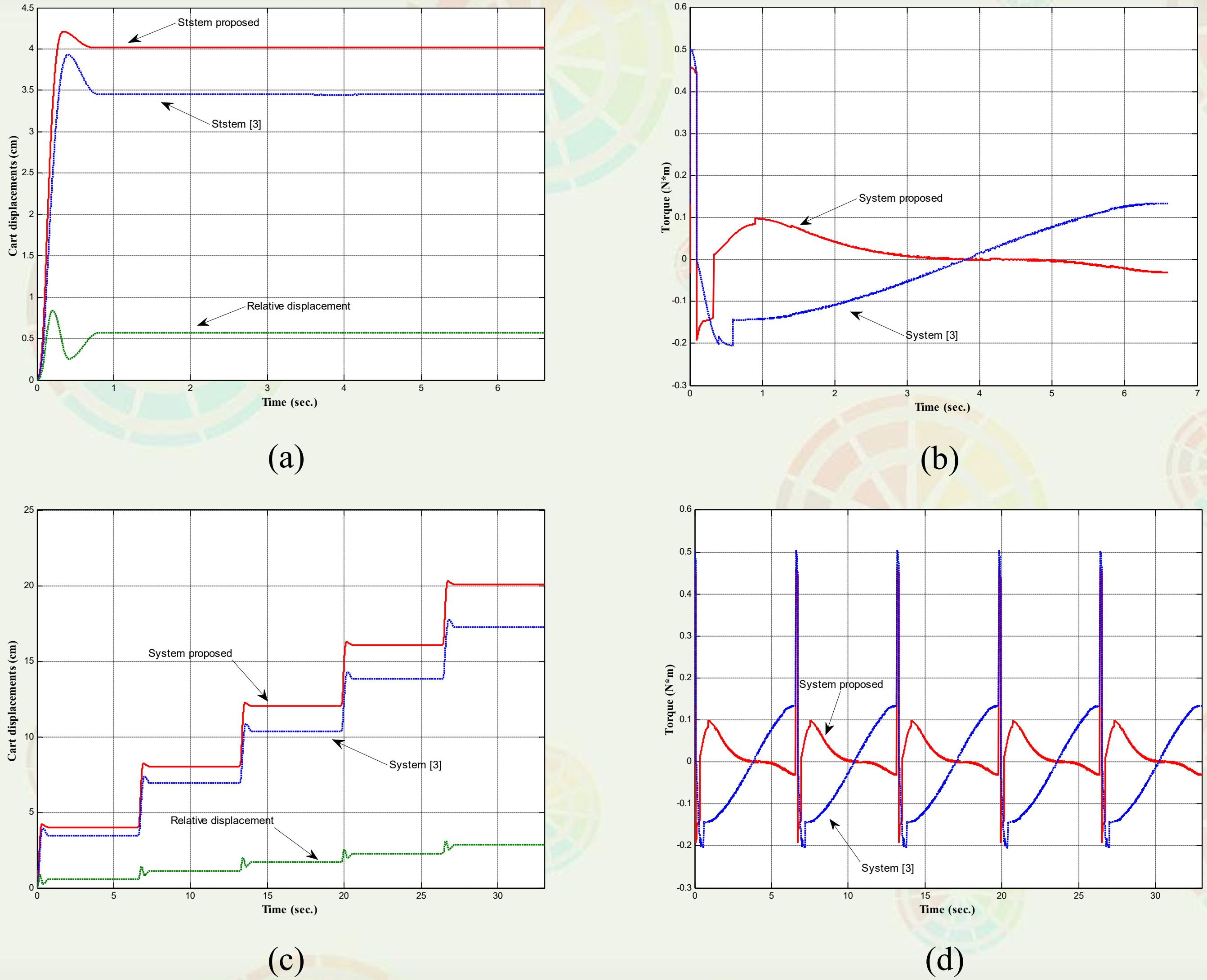
- Elastically joint-actuated cart-pole system



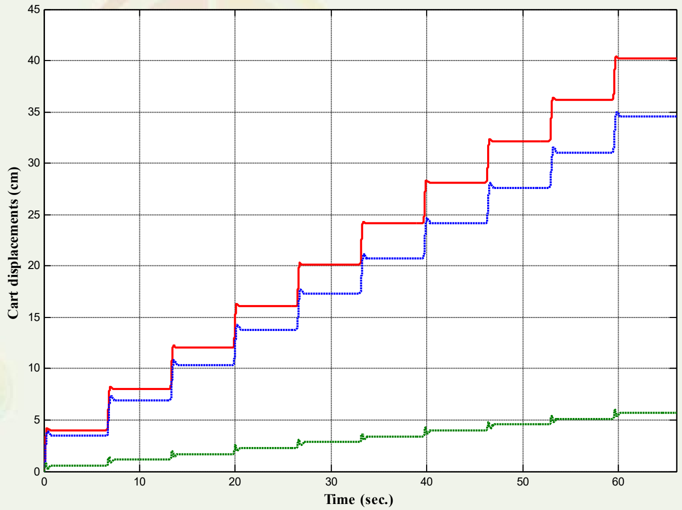
Elastically joint-actuated cart-pole system

Optimized angular velocity profile for one fully stroke

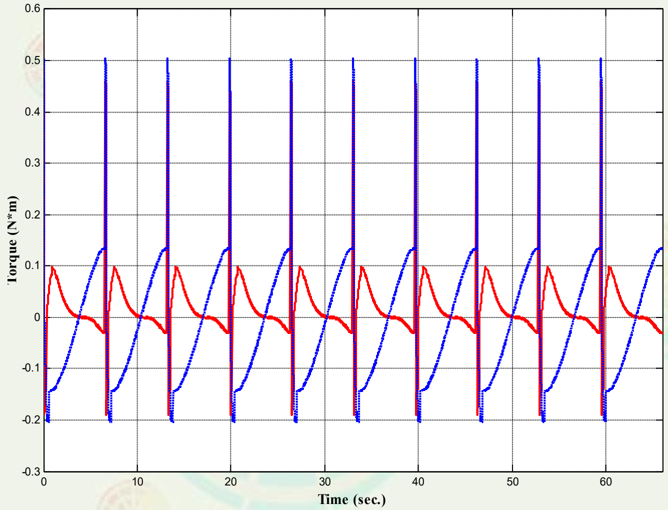
$$\dot{\theta}_d(t) = \begin{cases} 110.669t & 0 \le t < 0.1 \\ 11.0669 - 37.97(t-0.1) & 0.1 \le t < 0.33 \\ -4.094(t-0.9) & 0.33 \le t < 0.9 \\ -0.10928(t-0.9) & 0.9 \le t < 1.4 \\ -0.5464 & 1.4 \le t < 5.8 \\ 0.683(t-6.6) & 5.8 \le t < 6.6 \end{cases}$$



Comparisons of trajectories of cart displacement and control input for one and five cycles respectively under Collocated PFL technique



(a)



(b)

Comparison of trajectories of cart displacement and control input for ten cycles under Collocated PFL technique

APPLICATIONS

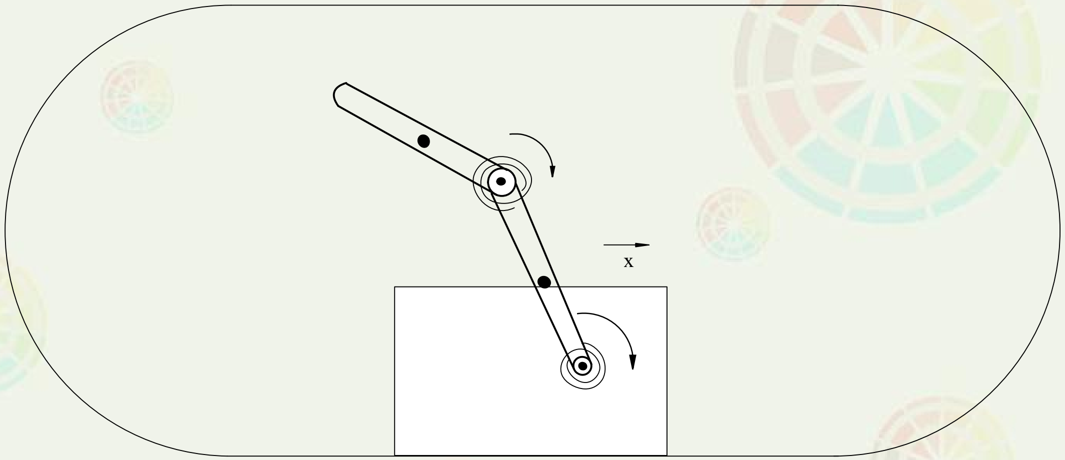
- Legged robot systems
- Manipulators
- Rescue robots
- Medical rehabilitation devices
- Haptic devices

CHALLENGES

- Controller design (highly nonlinear and strong coupling)
- Synchronization of motion cycles between different bodies
- Optimization of the parametric selection
- Nonintegrability of the system dynamics
- Characterization of second-order nonholonomic constraints

FUTURE WORKS

- Elastically Integrated Joints-Actuated Cart-Pole Underactuated System



Elastically integrated Joints-Actuated Cart-Pole Underactuated System

REFERENCE

[1] P. Liu, H. Yu, and S. Cang, “Modelling and control of an elastically joint-actuated cart-pole underactuated system,” the 2014 IEEE International Conference on Automation and Computing, 2014, pp. 26–31.

[2] P. Liu, H. Yu, and S. Cang, “Design, modelling and control of a capsule robot with hybrid propulsions for medical inspections and assistances,” the 5th BU Annual Postgraduate Conference, Bournemouth, 2014.

[3] G. A. Pratt and M. M. Williamson, “Series elastic actuators,” in International Conference on Intelligent Robots and Systems, 1995.

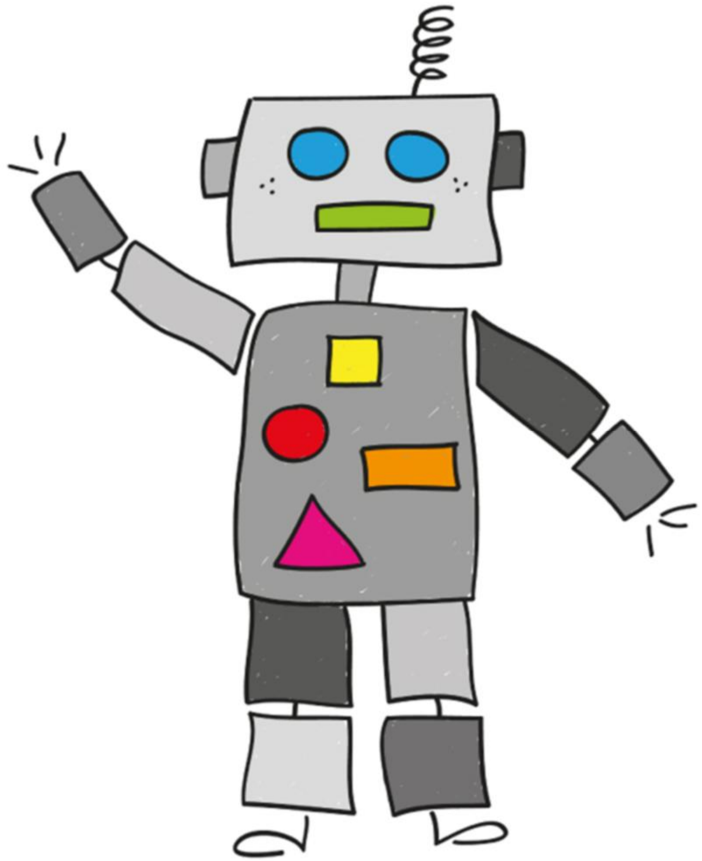
[4] J.E. Pratt, B.T. Krupp, “Series Elastic Actuators for legged robots,” Proceedings of SPIE - the international society for optical engineering, 2004.

[5] G.A. Pratt, “Low Impedance Walking Robots,” Integrative and Comparative Biology, vol. 42, pp. 174-181 ,2002.

[6] Gill A. Pratt, and Matthew M. Willamson, “Series Elastic Actuators,” IEEE International Conference on Intelligent Robots and Systems, vol. 1, pp. 399-406, 1995.

[7] J. Xiao, P. Liu, L. Jiao, H. Zhu, and Y. Du, “Design of PV power station remote monitoring system data acquisition device,” in IEEE International Conference on Advanced Mechatronic Systems, 2011, pp. 367–372.

QUESTIONS? THANK YOU!



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