

INTRODUCTION



<http://pixgood.com/snow-leopard-hunting.html> <http://wordlesstech.com/2011/02/23/hawk-chases-a-rabbit/>

Research

Bio-inspired Underactuated Robotics \cap

Applied Control Theory

- High Speed
- Ultra-Efficiency
- Super-Maneuverability
- Extreme-Agility

Highly Dynamic Robots

Needed in Society

- Unstructured / Remote / Unsafe Environments
- Disaster Response, First Response, Smart Bionics

Technological Capability

- Advances in Sensor / Actuator / Power / Computing Technologies / Mechanism Design Technologies

Project Aims & Objectives

- Investigating the challenges and the prospects of bio-inspired underactuated robots in various environments;
- Shedding light on the elaborate utilization of the bio-inspired characteristics;
- Monitoring and controlling the qualitative changes of system dynamics;
- Designing the robust adaptive controller to induce limit cycle motions.

CHALLENGES

Challenges all along remained are

- Hard-to-model (unknown models/principles)
- Controllability & maneuverability
- Effective underactuation
- Nonlinear dynamics & strong coupling
- Hybrid dynamics (impacts, frictions, contact conditions)
- Design of controllers that induce limit cycles rotation / hopping

Autogenetic Capsule Robot

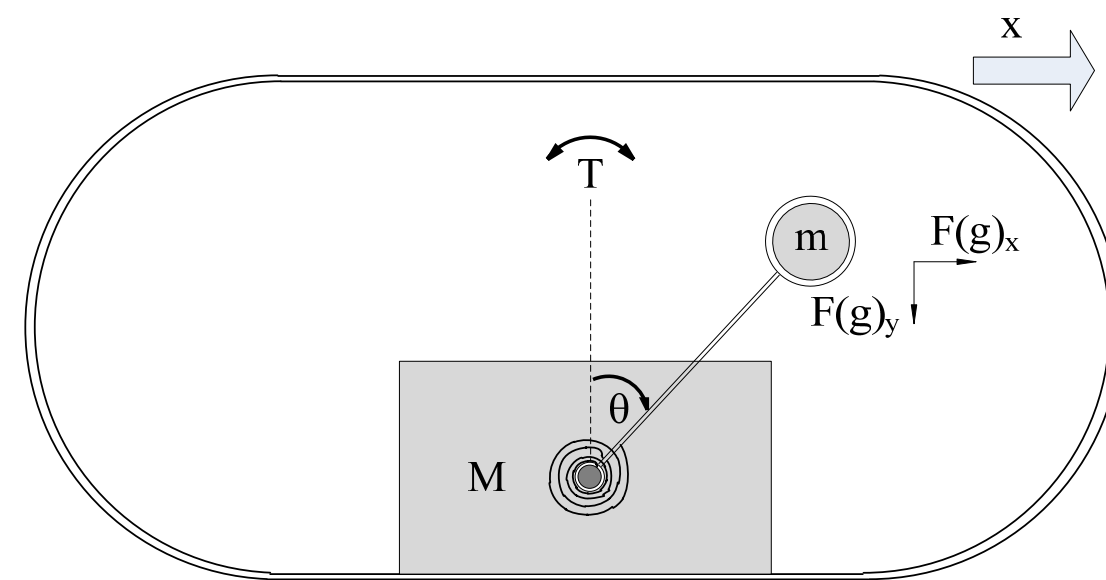


Fig. 1 Layout of the proposed capsule system

Nonlinear Analysis

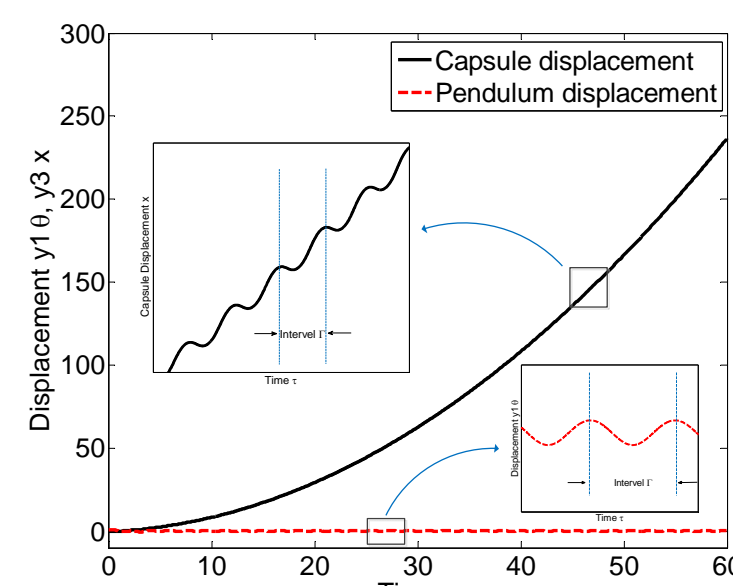


Fig.2 Typical time histories of angular displacement of the pendulum and the progression of the capsule

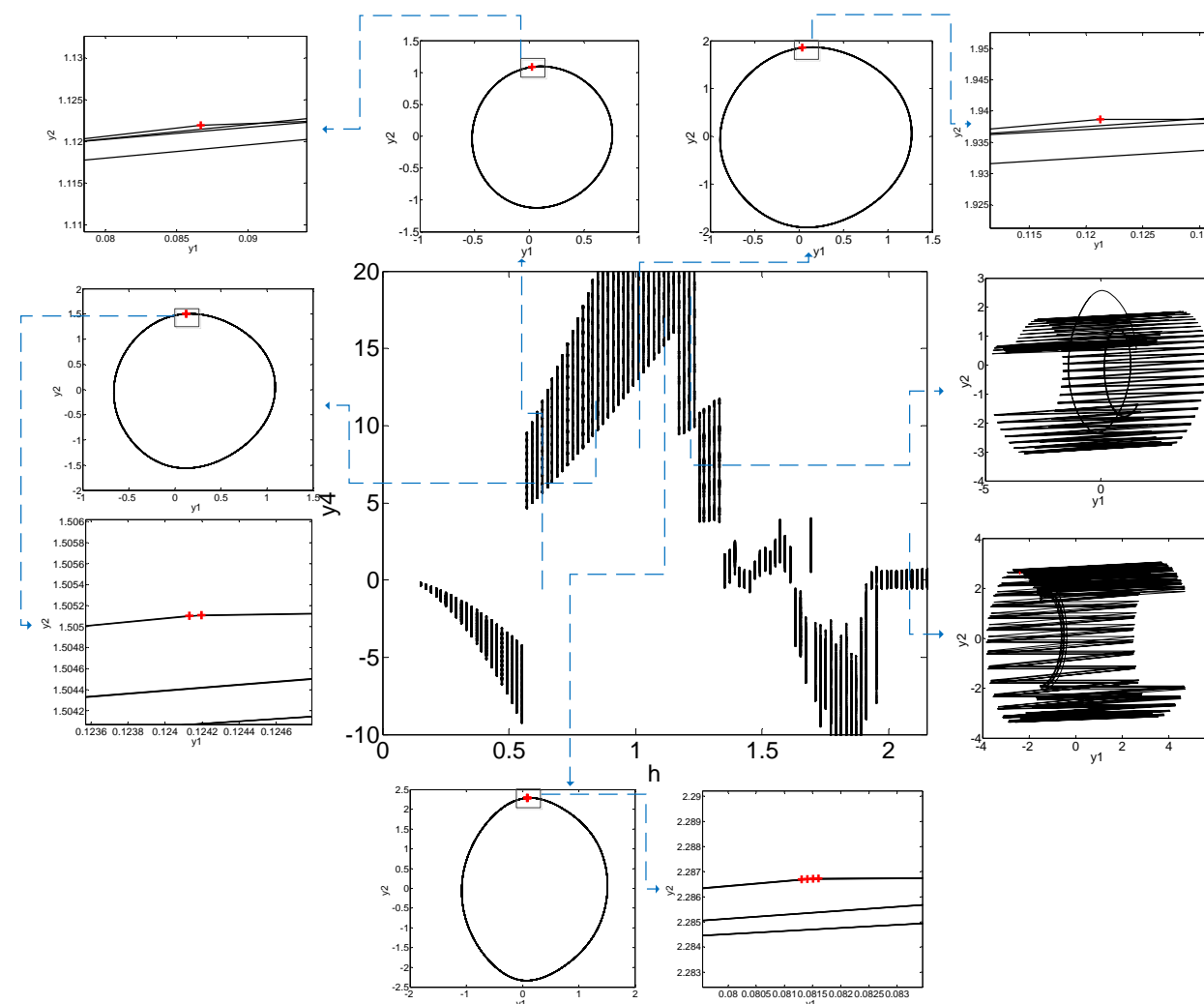


Fig. 3 The effect of varying nondimensionalized amplitude

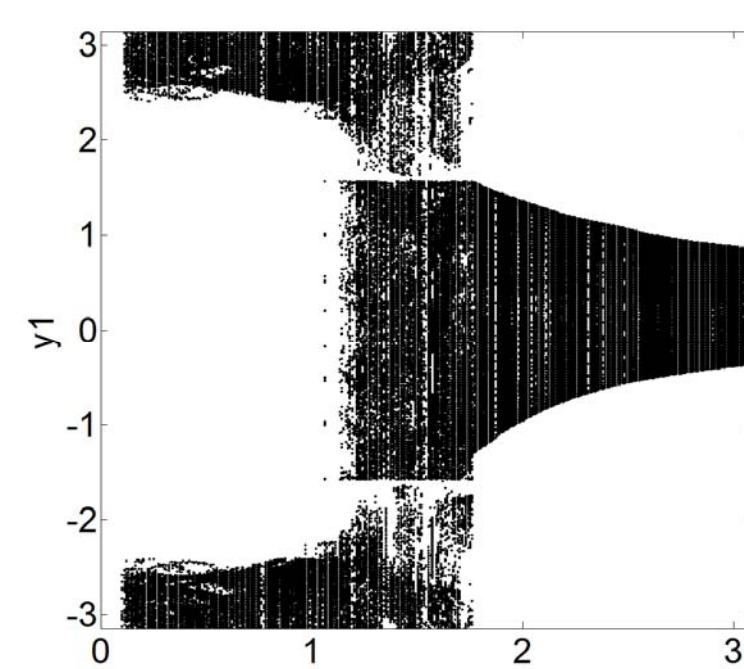


Fig. 4 The effect of varying nondimensionalized frequency

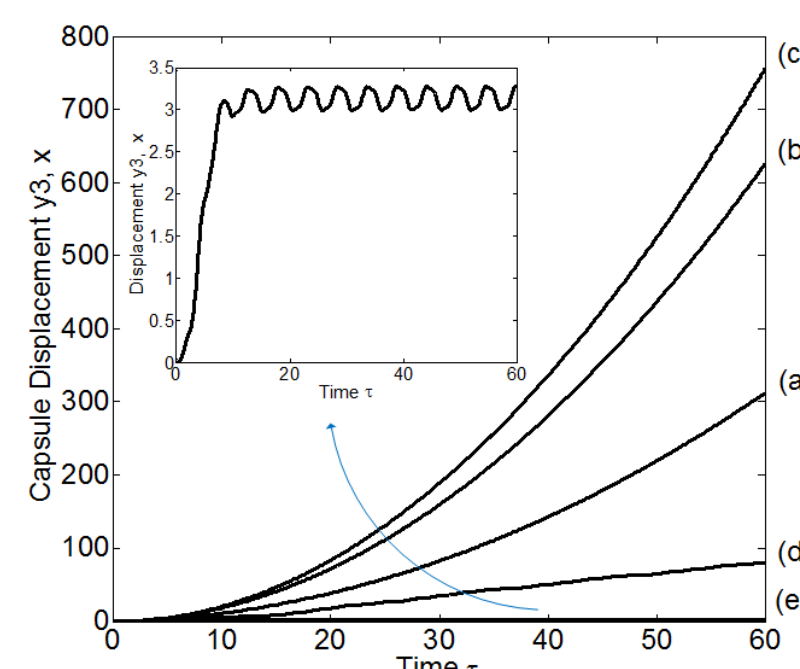


Fig. 5 Capsule progression under varying frequency

Synchronized Trajectory Generation

- Viscoelasticity profile
- Inverted pendulum motion profile

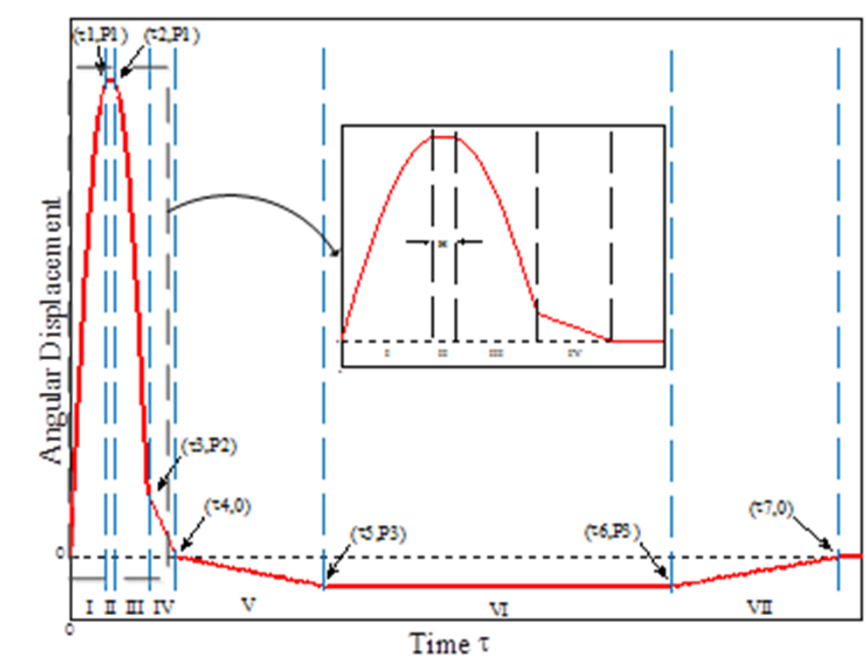


Fig. 6 Synchronized desired trajectory profile

Simulation Results

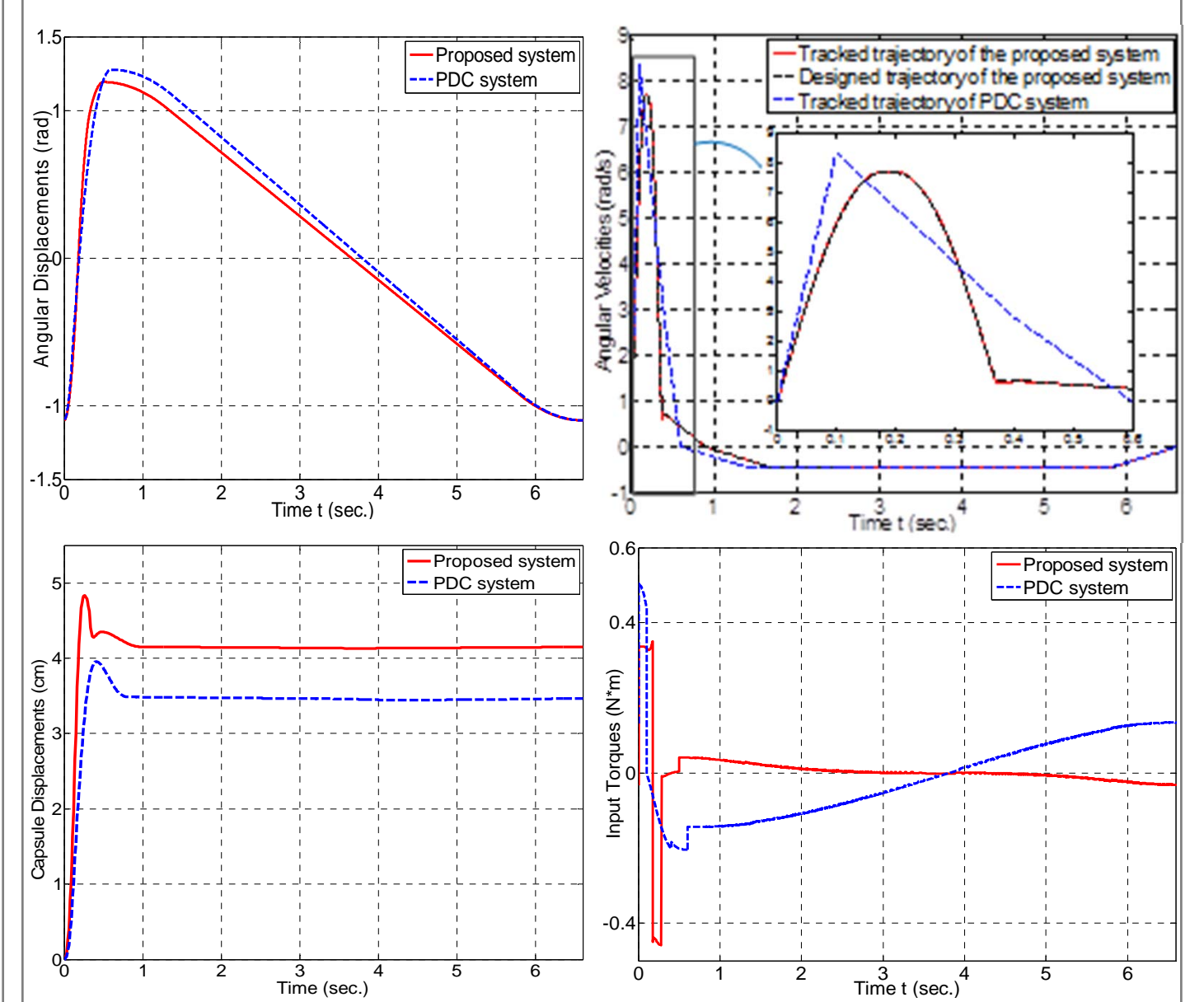


Fig. 7 Time histories of (a) the angular displacements, (b) capsule displacements, (c) periodic trajectories and (d) input torques under closed-loop control for one full cycle

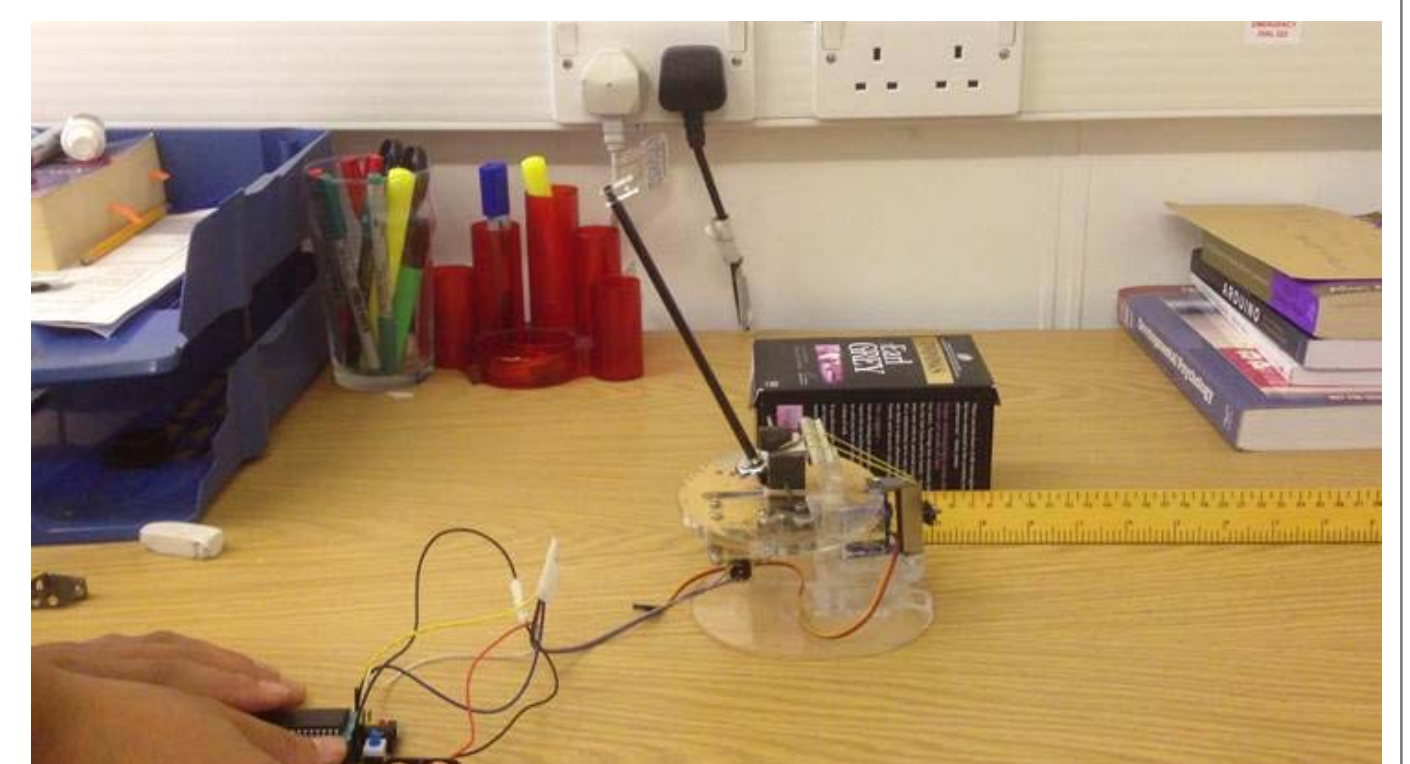


Fig. 8 The first generation prototype

APPLICATIONS

- ◆ Pipeline inspections
- ◆ Medical diagnosis assistants
- ◆ Rescue robot (environment investigations)
- ◆ Industrial robot
- ◆ Space robot
- ◆ Military robot

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