



# McGill Cyber-Physical Systems Lab (CPSL): An Introduction

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# Personal Introduction

## ■ Education

- BS, Mathematics, 1996  
Tsinghua University, China
- MS, Automation, 1999  
Tsinghua University, China
- PhD, Computer Science, 2006  
University of Illinois at Urbana-Champaign (UIUC), USA



# Personal Introduction

## ■ Work experience

- Visiting Faculty (on leave from McGill), 2006-2007  
HP Labs, Palo Alto, USA
- Assistant Professor, 2007 - 2009  
McGill University,  
Montreal, Canada
- Samuel R. Thompson Associate Professor, 2010-2011  
University of Nebraska Lincoln  
Lincoln, NE, USA
- Associate Professor, 2011 - present  
McGill University,  
Montreal, Canada





# Research Interests

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- Major research areas
  - 1) Real-time systems and networking;
  - 2) Power management of computing systems;
  - 3) Feedback control of computing systems;
  - 4) Fault tolerance and reliability;
  - 5) Wireless networks and wireless sensor networks;
  - 6) Social networks and emerging Internet applications;
  - 7) Control systems and technology.



# Research Interests (related to MPM)

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- Major research areas
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# Research Focus with MPM

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- I am a user of MPM
  - How to model complex CPS systems using MPM?
    - Which model for computations?
    - Which model for communications?
    - Integration of physical modeling and cyber modeling
  - Study the properties of CPS systems based on MPM
    - Real-time guarantee (Temporal properties)
    - Reliability
    - Safety
    - Stability
  - Optimize and control the performance of CPS



# Potential Topics

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- Coherent modeling of cyber and physical aspects of CPS
  - Mixture of continuous and discrete in nature
  - Physical systems are governed by time (e.g. using ODE or PDE for modeling), while computing systems traditionally are modelled without time (Turing machine)
  - When to use domain specific modeling?
- Co-simulation of C&P in CPS
- Analysis and control of CPS
  - Analyze the properties of CPS using MPM
  - Feedback control design using MPM



# Expectations

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- Learn more about MPM from the experts here  
😊
  - Foundations
  - Tools
  - Case studies
  - Challenges
  - ...
- Apply MPM in research related to CPS
- Find new opportunities and initiate exciting collaborations
- Having fun!





# Related Publications (1)

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## ■ Real-time systems and networking

- "Non-Utilization Bounds and Feasible Regions for Arbitrary Fixed-Priority Policies", **ACM TECS 2011**
- "A Real-Time Multicast Routing Scheme for Multi-Hop Switched Fieldbuses", **IEEE INFOCOM 2011**
- "Scheduling Design and Analysis for End-to-End Heterogeneous Flows in an Avionics Network", **IEEE INFOCOM 2011**
- "A Switch Design for Real-Time Industrial Networks", **IEEE RTAS 2008**
- "GD-Aggregate: A WAN Virtual Topology Building Tool for Hard Real-Time and Embedded Applications", **IEEE RTSS 2007**
- "On the Scheduling of Flexible and Reliable Real-Time Control System," **Real-Time Systems Journal, 2003**



## Related Publications (2)

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- **Feedback control of computing systems**
  - "PAUC: Power-Aware Utilization Control in Distributed Real-Time Systems, " **IEEE Transactions on Industrial Informatics (TII), 2010**
  - " Robust Fuzzy CPU Utilization Control for Dynamic Workloads, " **Journal of Systems and Software (JSS), 2010**
  - "Online Adaptive Utilization Control for Real-Time Embedded Multiprocessor Systems," **CODES+ISSS'08**
  - "Queueing-Model-Based Adaptive Control of Multi-Tiered Web Applications", **IEEE Transactions on Network and Service Management (TNSM) 2008**
  - "Feedback Control with Queueing-Theoretic Prediction for Relative Delay Guarantees in Web Servers", **IEEE RTAS 2003**



## Related Publications (3)

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- **Fault tolerance and reliability**

- "Reliability Calculus: A Theoretical Framework to Analyze Communication Reliability in Cyber-Physical Systems", **ICDCS 2010**
- "ORTEGA: An Efficient and Flexible Online Fault Tolerance Architecture for Real-Time Control Systems", **IEEE Transactions on Industrial Informatics (TII), 2008**  
( **Best Paper Award of IEEE TII 2008** )
- " Frequency-Domain Reliability Analysis and Modeling of Networked Control Systems," **FeBID'08, 2008**