GERMANY/HONG KONG JOINT RESEARCH SCHEME
THE PROJECT REPORT

(for Project Completion)

Project Number: G_HK022/12

Title

Profiling Faults in Cyber-Physical Systems for Dependability Assurance from a Hybrid Modeling Perspective

Particulars

	Hong Kong team	German team
Name of Project Co-ordinator (with title)	Dr. WANG Qixin	SURI Neeraj
Name of Co-Investigator (if any)		
Institution or Institutional affiliation	[ ] CityU [ ] HKU [ ] CUHK [ ] HKUST [ ] HKBU [ ] LU [ ] HKIEd [x] PolyU	[ ] University of _____ [x] Others: TU Darmstadt
Other project team members (if any)	WANG Yufei, TAN Feng	WINTER Stefan

Funding Period

	1st year	2nd year (if applicable)
Start Date	1/1/2013	1/1/2014
Completion Date	31/12/2013	31/12/2014

Objective(s) as per original application

1. Find proper models and dependability assurance metrics for profiling CPS fault.
2. Find ways to measure the chosen dependability assurance metric.
3. Find ways to characterize the perturbation bounds for requisite CPS dependability assurance.

Details of Report [Please attach relevant document(s)]

i) Outline of proposed research and results obtained

We plan to find a metric to quantify the impact of faults in a CPS system. Given the metric, we plan to propose a framework of methodology to measure this metric, and hence measure the bounds of tolerable faults.

We have proposed a hybrid model reachability based metric to quantify the impacts of faults in a CPS system. Given the metric, we propose a benchmark based methodology framework to measure the metric, and a Lyapunov stability theory based enhancement to speed up the methodology. Using this methodology framework, we can map each level of CPS fault to a quantitative impact value. On the other hand, given a impact value bound, we can derive the bound of the fault level.

ii) Significance of research results

There are methodologies to measure the fault impacts in simple CPS. However, when the cyber component is complex, the corresponding practical methodology is missing. Through this project, we proposed a methodology to fill this missing part of the solution framework.

iii) Research output

Top Journal paper:

[TPDS14Accepted] Feng Tan, Yufei Wang, Qixin Wang, Lei Bu, Neeraj Suri, "A Lease based Hybrid Design Pattern for Proper-Temporal-Embedding of Wireless CPS Interlocking," (accepted for publication) in IEEE Transactions on Parallel and Distributed Systems, 2014.

Top Conference Paper:

[DSN13] Feng Tan, Yufei Wang, Qixin Wang, Lei Bu, Rong Zheng, and Neeraj Suri, "Guaranteeing Proper-Temporal-Embedding Safety Rules in Wireless CPS: A Hybrid Formal Modeling Approach (with Corrigenda and Notes)," in Proc. of the 43rd IEEE/IFIP International Conference on Dependable Systems and Networks (DSN), 2013.

Journal Paper under Submission:

Feng Tan, Liansheng Liu, Stefan Winter, Qixin Wang, Neeraj Suri, Lei Bu, Yu Peng, Xue Liu, Xiyuan Peng, "Profiling Cross-Domain Noise for Gray Box Two-Level Control CPS".

Work-in-Progress Long Abstract:

[ICCPSWiP14] Feng Tan, Liansheng Liu, Stefan Winter, Qixin Wang, Neeraj Suri, Lei Bu, Yu Peng, Xue Liu, Xiyuan Peng, "WiP Abstract: A Framework on Profiling Cross-Domain Noise Propagation in Control CPS," in ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS'14) Work-in-Progress Session, Berlin, Germany, April, 2014.

iv) Potential for or impact on further research collaboration

This project served as a pilot study for the PI and German side PI for further studies on dependability issues in Cyber-Physical Systems in general. With the ability to profile fault propagation in CPS, we plan to further study how to avoid, constrain, and heal faults in CPS.