Internship

"Predictive Control, Learning and Analysis for Large Mobile Networks"

Chung-Shue (Calvin) Chen

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Duration: **6 months**
Starting date: Available immediately
How to apply: Email me with your CV, academic transcript (grades), recommendation letter (optional)

Description of the Internship

The rapid developments of smart devices and mobile applications have significantly increased their penetration level and also the importance of human factor in the performance of information and communication systems, including mobile networks and IoT. This change has brought to us new technical challenges for satisfying user requirements, e.g., in increasing system dynamics, agent selfishness, strict latency guarantee, and massive connectivity. On the other hand, it also presents unique opportunities for enhancing system performance and user quality of experience (QoE), for example by exploiting human behavior patterns and system characteristics. The main objective of this work is to develop a general mathematical framework and efficient algorithm for large mobile networks with growing human factors. Scenarios include 5G, machine-to-machine networks, and IoT. In these systems, human users interact extensively with the system, and the user-perceived quality of experience is critical. We aim to bring together analytical and learning tools in network optimization, control theory, and user context awareness, and investigate fundamental limits to benefit future mobile network and service. Results can benefit not only emerging new mobile and IoT technology, but also advance the mathematical fields including automatic control, optimization, queueing, and large networks, with ultimate objective of guaranteeing superior QoE and scalable solutions in resource-limited networks.

Tasks

1. Formulate general mathematical model of large mobile network taking into account human factor and user context.
2. Consider advanced algorithm and online optimization method under system constraints.
3. Investigate possible heuristics and evaluate performance in comparison.
4. Describe the work in a technical report and perform simulation studies.

The intern will finalize its training by describing the work in a technical report. It is the objective to submit suitable technical contributions as future proposals and to summarize the most relevant results in a research paper, which can be submitted to a distinguished research conference or journal. It can also be considered as a preliminary work for a PhD program.

Criteria

Skills:
- Simulation: intermediate level - MATLAB, C or similar
- Mathematical: intermediate level. Understanding of optimization problem, control theory, queueing model, probability and random process, statistical model. Knowledge of information, communication and optimization theory is a definite plus

Quality:
- Good knowledge of mobile networks, information and communication systems, and radio resource management (e.g. TDMA, FDMA, power control, etc.) would be appreciated; knowledge of 5G, IoT and simulation is a definite plus

Language:
- English (fluent)
- We are in a multi-culture multi-language work environment

References

[1] F. Boccardi, R. W. Heath, A. Lozano, T. L. Marzetta, and P. Popovski, “Five disruptive technology directions for 5G,” IEEE Communications Magazine, vol. 52, no. 2, pp. 74-80, Feb 2014.
[2] IEEE JSAC Special Issue (2017). Online available: http://www.comsoc.org/jsac/cfp/human-loop-mobile-networks
[3] L. Huang, C. W. Sung, and C. S. Chen, "Joint power control and scheduling for context-aware unicast cellular networks", IEEE Vehicular Technology Conference (VTC), May 2016.
[4] C. S. Chen and G. E. Oien, "Optimal power allocation for two-cell sum rate maximization under minimum rate constraints," IEEE International Symposium on Wireless Communication Systems (ISWCS), pp. 396-400, 2008.
[5] V. M. Nguyen, C. S. Chen, and L. Thomas, "A unified stochastic model of handover measurement in mobile networks," IEEE/ACM Transactions on Networking (TON), 2013.