

第 36 回先進スーパーコンピューティング環境 (ASE) 研究会実施報告

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東京大学情報基盤センターASE 研究会 (Advanced Supercomputing Environment) は内外からの講演者を招いて不定期に開催している。2018 年 7 月 27 日 (金) に実施された第 36 回 ASE 研究会¹では, Franz Franchetti 教授 (Carnegie Mellon 大学) に, 計算コードの自動合成について, ご講演をいただいた。Franchetti 教授らが提唱する operator language およびその実装である SPIRAL を用いてアルゴリズム記述すれば, FPGA 用 Verilog や GPU 用 CUDA など, 対象システムに最適化されたソースコードの自動生成が可能とのことである。学内外から合計 7 名の出席者があり, 活発な議論が行われた。



写真 : Franz Franchetti 教授

表 1 プログラム

時間帯	講演者	題目
11:00 - 11:05	Akihiro Ida (ITC, The University of Tokyo)	Welcome & Opening
11:05 - 12:05	Franz Franchetti (Carnegie Mellon University)	Formal Software Synthesis of Computational Kernels
In this talk we address the question of how to automatically map computational kernels across a wide range of computing platforms to highly efficient code, and prove the correctness of the synthesized code. This addresses two fundamental problems that software developers are faced with: performance portability across the ever-changing landscape of parallel platforms, and verifiable correctness of sophisticated floating-point code. The problem is attacked as follows: We develop a formal framework to capture computational algorithms, computing platforms, and program transformations of interest, using a unifying mathematical formalism we call operator language (OL). Then we cast the problem of synthesizing highly optimized computational kernels for a given machine as a strongly constrained optimization problem that is solved by a multi-stage rewriting system. Since all rewrite steps are semantics preserving identity operations, our approach allows us to formally prove the equivalence between the kernel specification and the synthesized program. We have implemented this approach as part of the SPIRAL system where we have formalized a selection of computational kernels from the signal and image processing domain, software-defined radio, and robotic vehicle control. We have targeted platforms spanning from mobile devices as well as desktop and server multicore processors to large high performance and supercomputing systems. Our provably correct synthesized vehicle safety monitors and controllers have been demonstrated on an unmanned ground robot and a passenger car.		
12:05 - 12:10	Akihiro Ida	Closing

¹ <https://www.cc.u-tokyo.ac.jp/events/ase/36/36.php>