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主　論　文　の　要　旨

論文題目　Software Platforms for Modern Embedded Systems: Techniques Towards Productivity, Reliability and Scalability (組込みシステムのソフトウェアプラットフォーム：生産性、信頼性、スケーラビリティに関する技術)

氏　　名　　李　奕驍

論 文 内 容 の 要 旨

The increasing complexity of modern embedded systems makes software platform techniques more necessary than ever. Even the cheapest devices can have advanced connectivity now. For high-end embedded systems (e.g. autonomous vehicles), multi/many-core processors are adopted to satisfy the growing demand for computing power. Productivity, reliability and scalability are essential requirements for a software platform. In this dissertation, some major open issues are introduced at first. Three studies -- EV3RT, FMP-MC, ESPROF -- are then presented to shed some lights on and discuss possible solutions to them.

In the study of EV3RT, how to build a reliable RTOS-based platform meeting both real-time performance and connectivity requirements, with significantly reduced implementation effort, for Mindstorms EV3 robotics kit is explained. A dynamic module loading mechanism for static OS design is proposed to improve the productivity of development process. The performance and footprint are compared with Linux-based platforms to show the advantages for resource- and time-critical applications.

In the study of FMP-MC, a testbed for running high-performance applications on traditional multi-core RTOS is created. By a comparative analysis with Linux on a many-core processor, several bottlenecks commonly existing in RTOSes are identified and resolved. Multiple parallel applications from PARSEC are used for evaluation. The results indicate that traditional multi-core RTOS can be optimized to deliver good scalability on many-core.

In the study of ESPROF, a generic source-level profiling infrastructure for multi/many-core embedded systems is proposed. It allows user to flexibly and effortlessly create optimized tools with advanced algorithms. A scalable call graph profiler is implemented as an example, and shows much higher accuracy with very low overhead compared to existing tool in measuring benchmark application on a 36-core platform.

Besides proposed solutions to those directly addressed issues, all the studies are open-source and can provide some conceptual and practical bases for further research. The state of the art and some noteworthy trends about techniques related to software platforms for future embedded systems are also discussed.