Modular Software for Real-Time Quantum Control Systems

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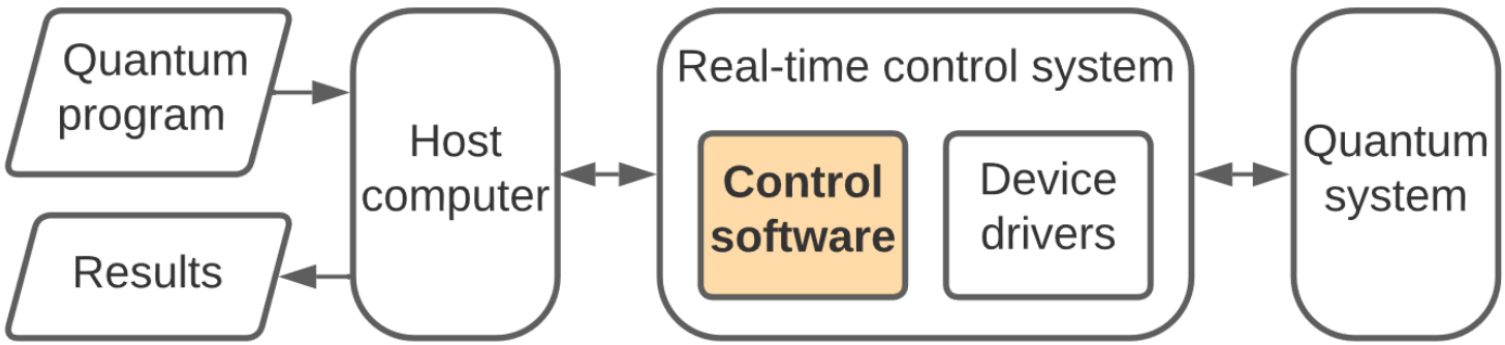
Overview


Quantum program
Results
Host computer
Real-time control system
Control software
Device drivers
Quantum system

Overview

Presents modular software architecture for quantum control systems

Goals: Flexibility, portability, performance

Introduces Duke ARTIQ Extensions (DAX) framework

Modular Software Architecture

Modules - group devices with tight control needs

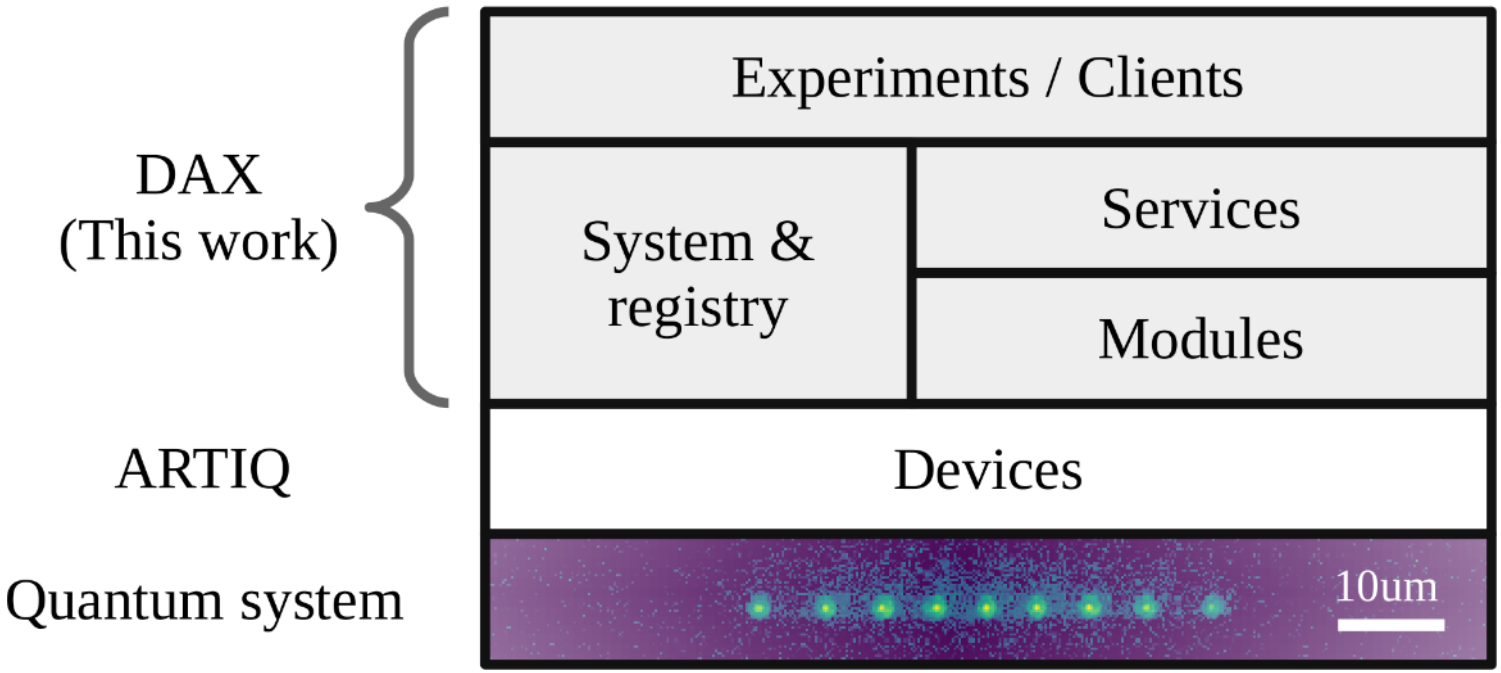
Services - system-wide functions using modules

Registry - central catalog of modules and services

Interfaces - standard functionality descriptions

Clients - portable code using interfaces

Modular Software Architecture



Experiment

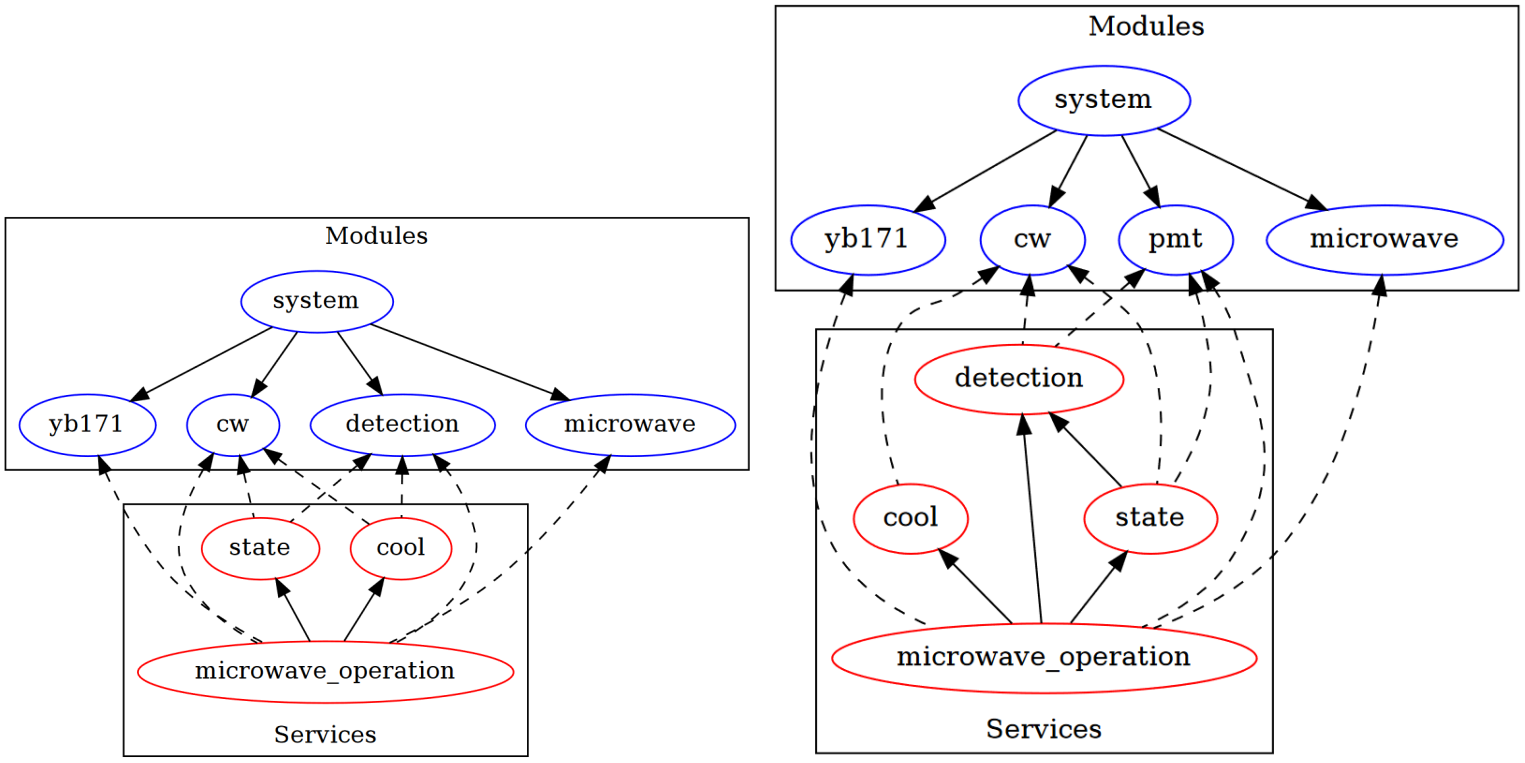
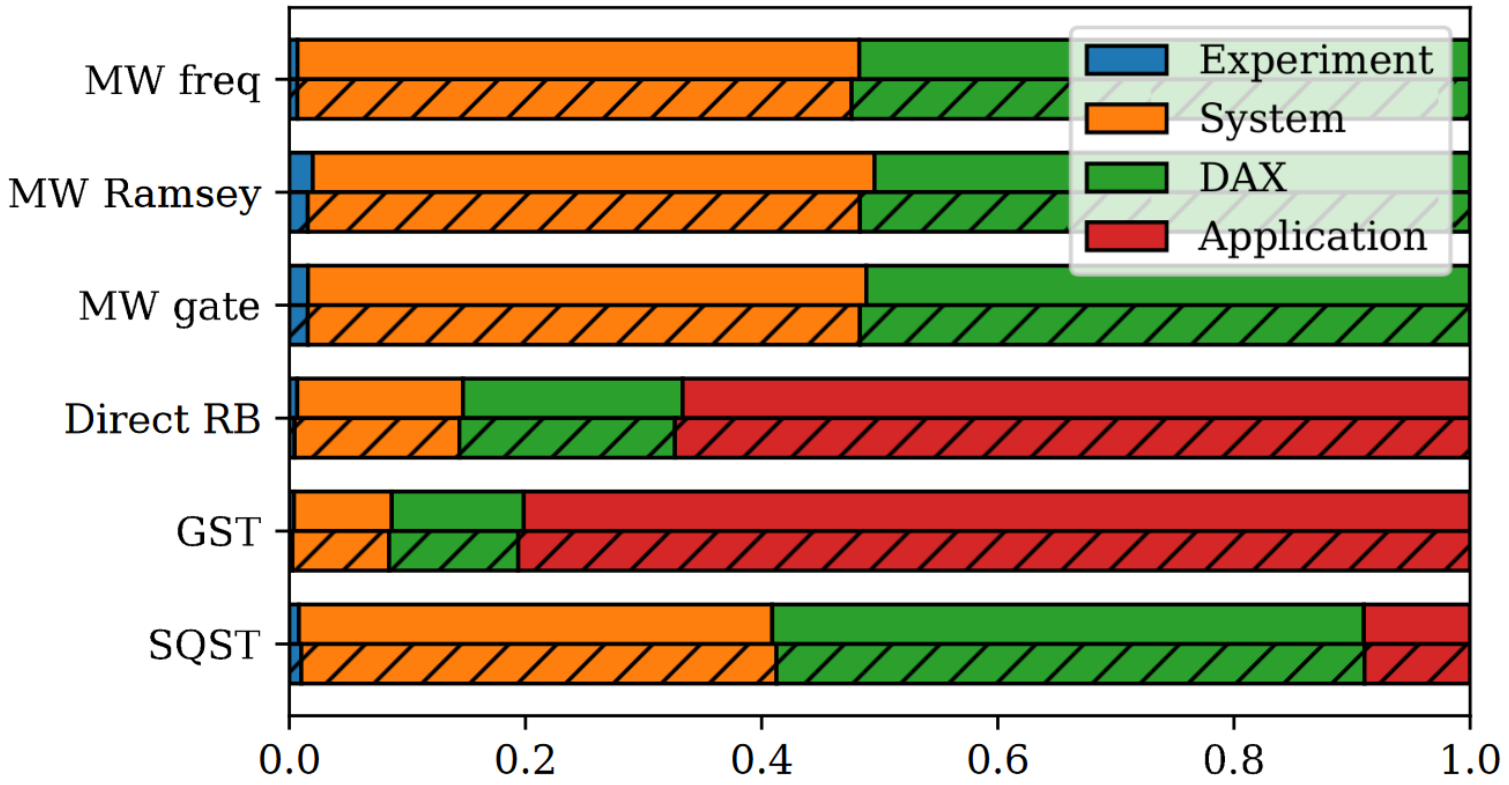
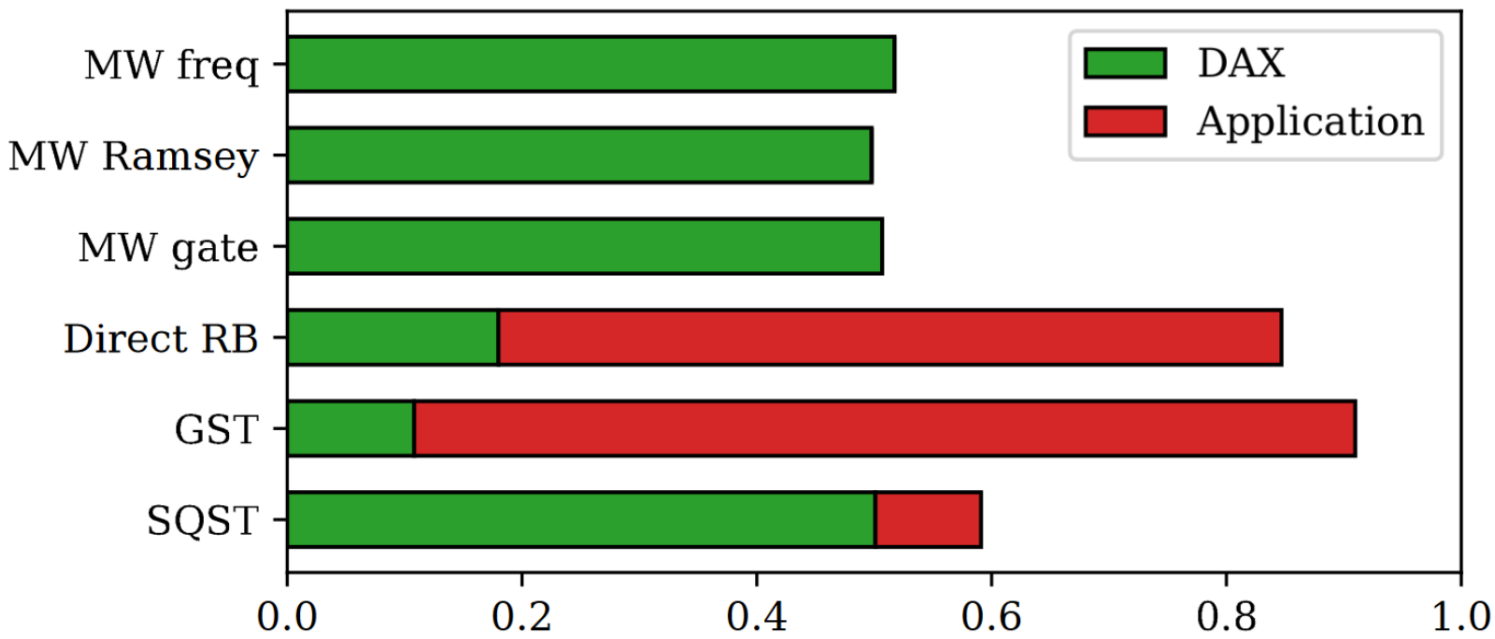


Figure: SATQ and RC Experiment

Code Reuse Analysis



Code Reuse Analysis



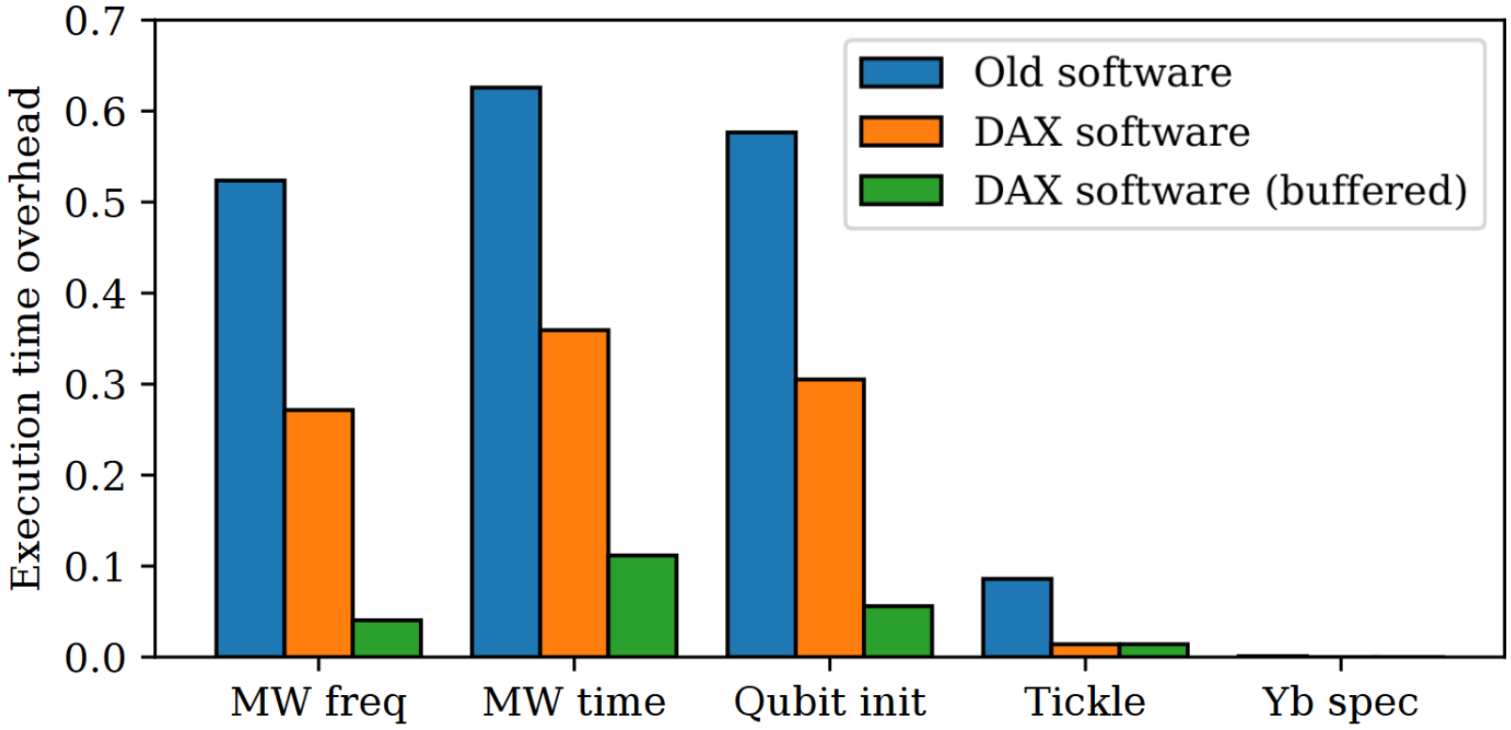
Performance Evaluation

63% lower execution overhead vs non-modular code

Similar binary size

Fine-grained timing management and data offloading

Performance Evaluation



Conclusion

Modular architecture enables portable quantum control software

Reduces development overhead as hardware evolves

Important step towards scalable quantum systems