Contributions to OpenROAD from Abroad: Experiences and Learnings

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Introduction

We present:
How to become a contributor to the OpenROAD project (desired skills, differences from academic research)
The tools developed by us in the OpenROAD project (lessons learned from developing tools for real production ICs)
Challenges experienced and best practices adopted when working in a large project from abroad)

Becoming a contributor

Not research as usual
Build to last → Code quality and unit tests
Deliverables-driven

Recruiting
VLSI skills "vs" programming skills
Senior project members work together with undergrad CS and ECE students → New EDA talents!

Logistics
UCSD visiting student status
Access to servers and enablements
Internet connection
Language barrier

Our contributions

OpenROAD flow

Tools developed entirely for the project
Tapcell
Straightforward task → lack of academic / open-source code
Support for 130nm down to 14nm
Logic developed by an experienced PD methodologist

ioPlacer
Neglected subject in VLSI CAD literature
Need to find I/O pin locations in block-level design
Fast and scalable Hungarian matching with divide-and-conquer

Research code adapted for the OpenROAD flow
TritonCTS
Adapted from the academic code GenHTree
First open-source release removed all commercial tool dependencies, being a mix of C++ code and Tcl scripts → algorithm not scalable / code not extensible
Implementation of a second version, written from scratch in C++ → simple H-Tree code, integration with the project’s STA tool, with support for clock gate cells, multiple clocks, generated clocks

FastRoute
Original code by Pan et al.7 for a VLSI CAD contest
Overcoming code limitations: hard-coded max number of pins, layer direction, grid size, pin layers
Integration with detailed router: output in the guides file format
New features: technology tuning, antenna repair, parasitic estimation

The OpenROAD Experience

Working environment
Not research, not a company
Working with different universities and cultures!
Brazilian team unique characteristic: undergrad students
Valuable experience to future carrier
Working with industry veterans

Team organization and task management
Team is geographically spread → time zones impose a difficulty
Kanban-based project with Jira
"Task"-driven organization
Unified repository and Continuous Integration
Tools are in constant improvement in parallel projects
Integration of the tools into an unified repository
"Stable branch" for users
Per-tool unit tests and flow tests

References

[1] https://github.com/The-OpenROAD-Project/OpenROAD-flow-scripts