

Collaboration Beyond the Database: OpenAccess Gear

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Overview



- **OpenAccess Gear Motivation**
 - Introduction
 - Example: Timing-Driven Placement
- OpenAccess Gear Description
 - Overview
 - Components
- Future Directions

Introduction: Why Academic Research?



- **Academic work is a cornerstone of EDA research**
 - Many new algorithms come from academia
 - Vital source of “bleeding-edge” development
 - Testbed for untried technologies
- Research importance recognized through industry funding
- Industry should seek most “bang for buck” by **promoting OA for academic use**

The Problem



- **Academic researchers are reluctant to use OA**
- OA can be a relatively large investment of time/effort
 - Existing academic frameworks are simple and “good enough” to get papers published
- OA is a weak value proposition for academia
 - Researchers ask: “What do I get out of it?”
 - Answer: “OpenAccess (only)”

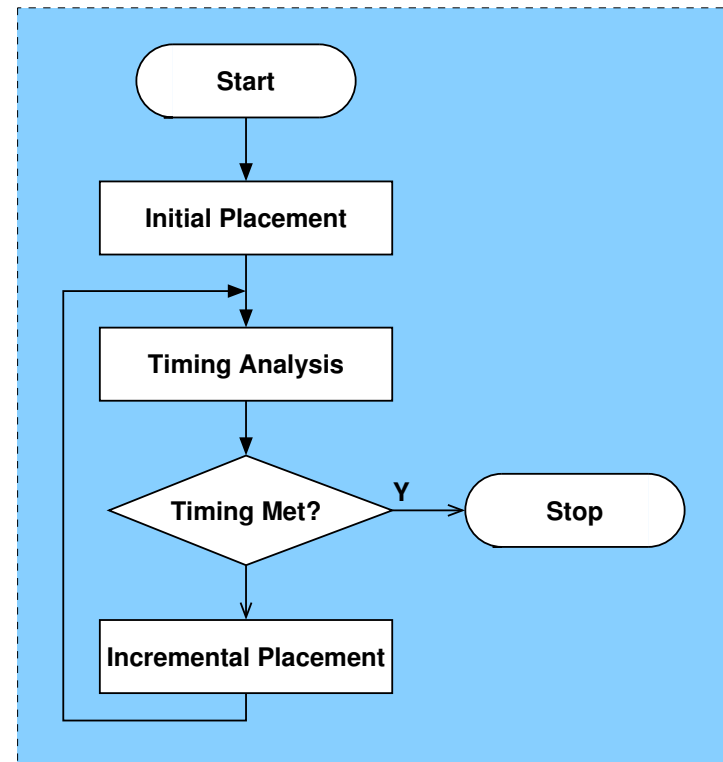
Our Solution



- **Offer academics more incentive to use OA**
- Give them more than just the OA database to work with
- Allow them to create systems which would be impossible otherwise
 - Their papers become better, more readily accepted/published
- **OpenAccess Gear** was created to generate this incentive
 - Library of utilities and components built on top of OA which are useful for academic researchers in EDA

Example: Timing-Driven Placement

- Problem: Placement researcher wants to experiment with timing-driven placement
- Two requirements: timing engine and integration framework (OA)
- Without timing engine: researcher forced to abandon idea
- **OA Gear provides the timing engine: enables researcher to follow through**



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OA Gear Overview



- Project started in 2004 at CBL
 - Two student interns over three months
- Open-source development model
 - Critical for acceptance in academic environment
 - Fosters transparency of code/results
 - Enables code contribution from end-users
- Free for all purposes, including commercial use
 - Academics need not worry about licensing issues
 - Industry can productize tools developed with OA Gear

OA Gear License



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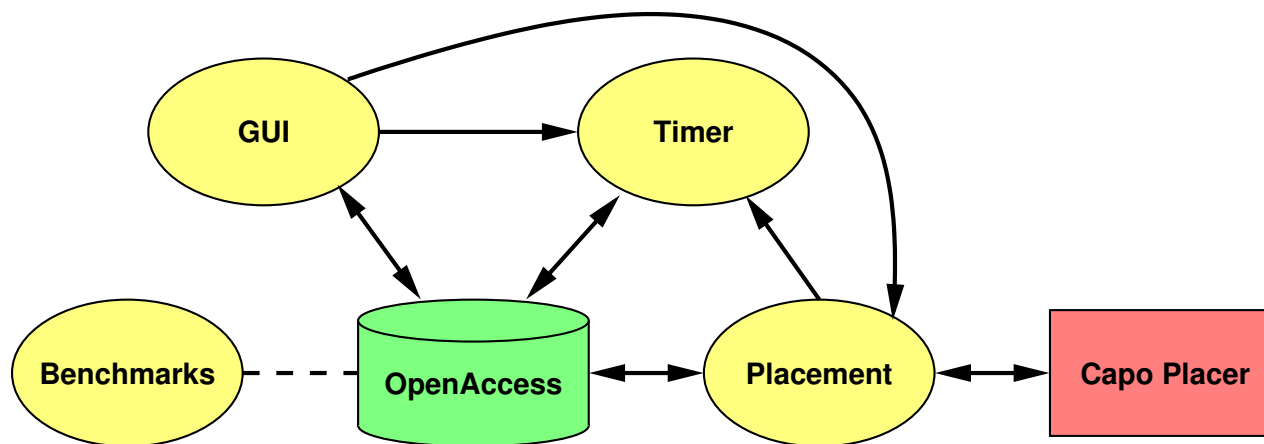
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OA Gear Components



- Currently OA Gear has four main components, chosen for their relative importance to EDA physical design research
 - **Timer**: Industrial-quality timing analysis engine
 - **Placement**: OA wrapper for Capo placement tool
 - **GUI**: Extensible graphical user interface
 - **Benchmarks**: Designs for academic research



OA Gear Timer

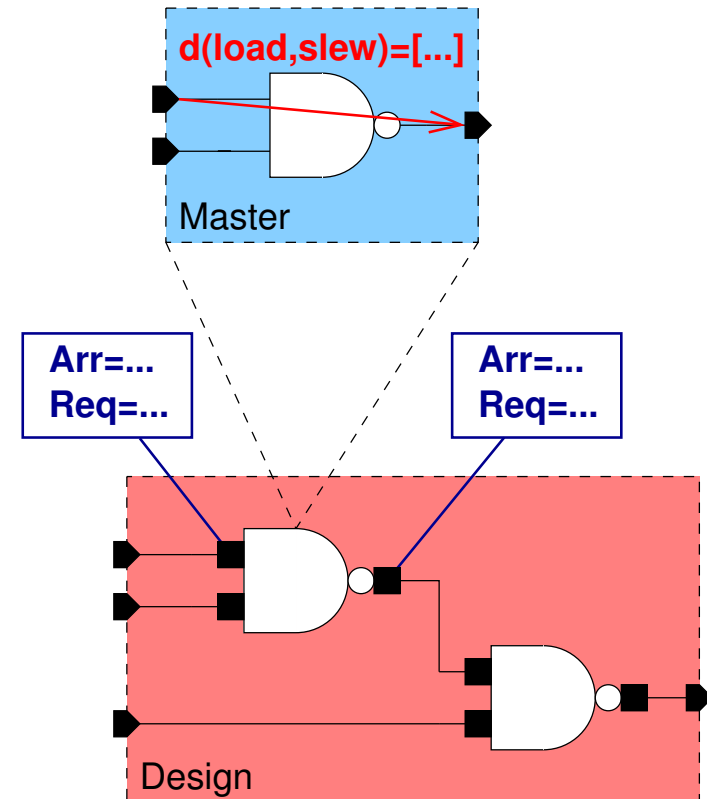


- Native OA static timing analysis engine
- Both full (entire design) and incremental (callback-based) timing modes
- Support for `.lib` and `.tlf` timing libraries
- Supports subset of `.sdc` timing constraints
 - Clock period, input delay/drive strength, output load
- Flexible, user-extensible wire delay modeling
 - C++ code can be added for arbitrarily detailed models
- Results vetted against Cadence commercial timer

Timer: Technical Overview



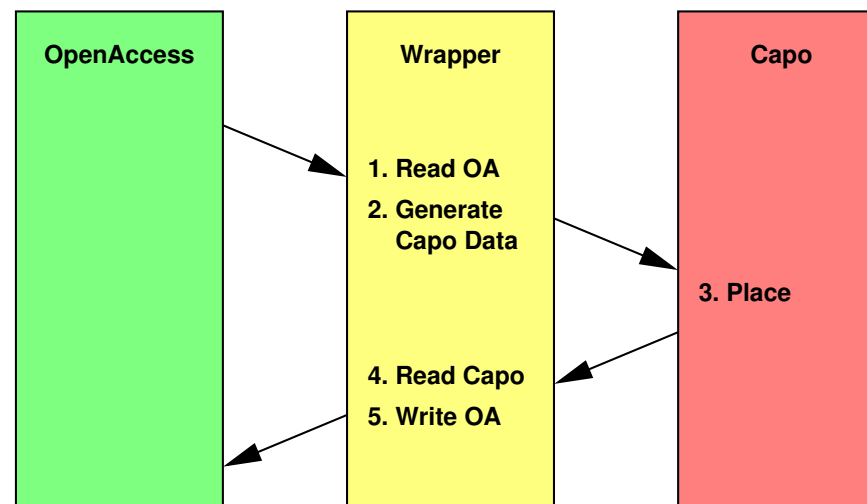
- Timing data stored in `AppDefs`
- In cell library, `Terms` annotated with delay paths through each standard cell and corresponding 2-D lookup table models
- In design, `InstTerms` and `Terms` annotated with delay information (arrival/required times, slew, etc.)
- Works on flattened block (move to EMH in future)



OA Gear Placement



- Wrote an **OA wrapper** around Capo (UCLA placement tool)
 - Existing tool data structures can be used as-is
 - Minimizes porting effort
 - Downside: minor loss of efficiency



Incremental Placement

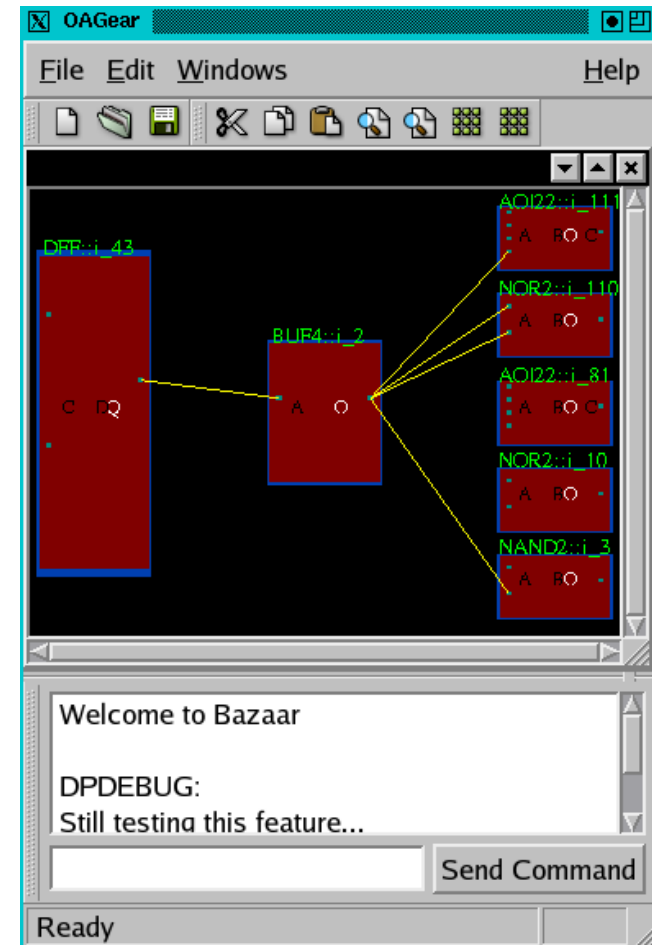


- Idea: wrapper invokes Capo on **subsections** of the original OA design, rather than entire design
- Allows for incremental placement/partial execution of Capo flow
- Have tried some prototype experiments in adding timing-driven placement support to Capo using this mechanism
 - Interleaved timing analysis with incremental placement
 - Preliminary results seem promising

OA Gear GUI



- Two main components
 - Layout viewer (geometries from oaMaskLayout view)
 - Netlist browser (connectivity information only)
- Extensible: users can easily add display of other information
 - E.g. timing information annotated onto layouts
- Based on OpenGL and QT (license required for commercial use)



OA Gear Benchmarks



- Two sets of benchmark circuits available
- Open/freely distributable benchmarks
 - ISCAS89 designs mapped to a hypothetical 250nm cell library
 - Designs included with OA Gear as examples/unit test data
- Restricted benchmarks
 - Faraday benchmark suite mapped to Cadence GSC cell library
 - Licensing conditions prohibit bundling with OA Gear
 - Downloadable from separate web site

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Future Directions



- Planned public release: November 2004
- OA Gear is an ongoing development effort
 - Improving current components
 - Ideas for new components (e.g. synthesis)
 - Encourage contributions from community

Credits



- David Papa, University of Michigan
- Zhong Xiu, Carnegie Mellon University
- Christoph Albrecht, Cadence Berkeley Labs
- Philip Chong, Cadence Berkeley Labs
- Andreas Kuehlmann, Cadence Berkeley Labs

<http://oagear.sourceforge.net/>