

Covering Arrays, Algorithms & Optimization (CALGO)

Mathematics for Testing, Reliability and Information Security (MaTRIS) Research Group^a

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CALGO: Core Topics

- ▶ CAs and their connections to other fields of Discrete Mathematics
- ▶ Modelling methodologies
- ▶ Development of tools
- ▶ Algorithmic generation of Covering Arrays (CAs)
- ▶ Algorithms for coverage measurement
- ▶ Theoretical constructions of CAs

Algebraic Approaches (TAPE)

- ▶ **Goal:** Use algebraic methods to model, reason about and compute CAs
- ▶ **Idea:** Translate coverage requirements of CAs to equation systems of multivariate polynomials
- ▶ **Methodology:** CAs arise as points in varieties when applying solvers relying on Gröbner Bases
- ▶ **Real-World Challenges:** Runtime of solvers
- ▶ **Future Work:**
 - ▷ Analyse structure of equation system for dedicated solvers
 - ▷ Integrate applied modelling requirements for CAs (constraints, weights, etc.)

A Plug-in construction for CAs

- ▶ **Goal:** Construct CAs with more factors from CAs with less factors
- ▶ **Idea:** Adapt plug-in construction from classic design theory for CAs
- ▶ **Methodology:** Make use of coverage inheritance
- ▶ **Application:** Combinatorial Testing for contemporary composed Software Design
- ▶ **Implementation:** λ Haskell

W_1	W_2	W_{k-1}	W_k
		$(S_i)_{i=1}^k \times \mathcal{M}$		
			

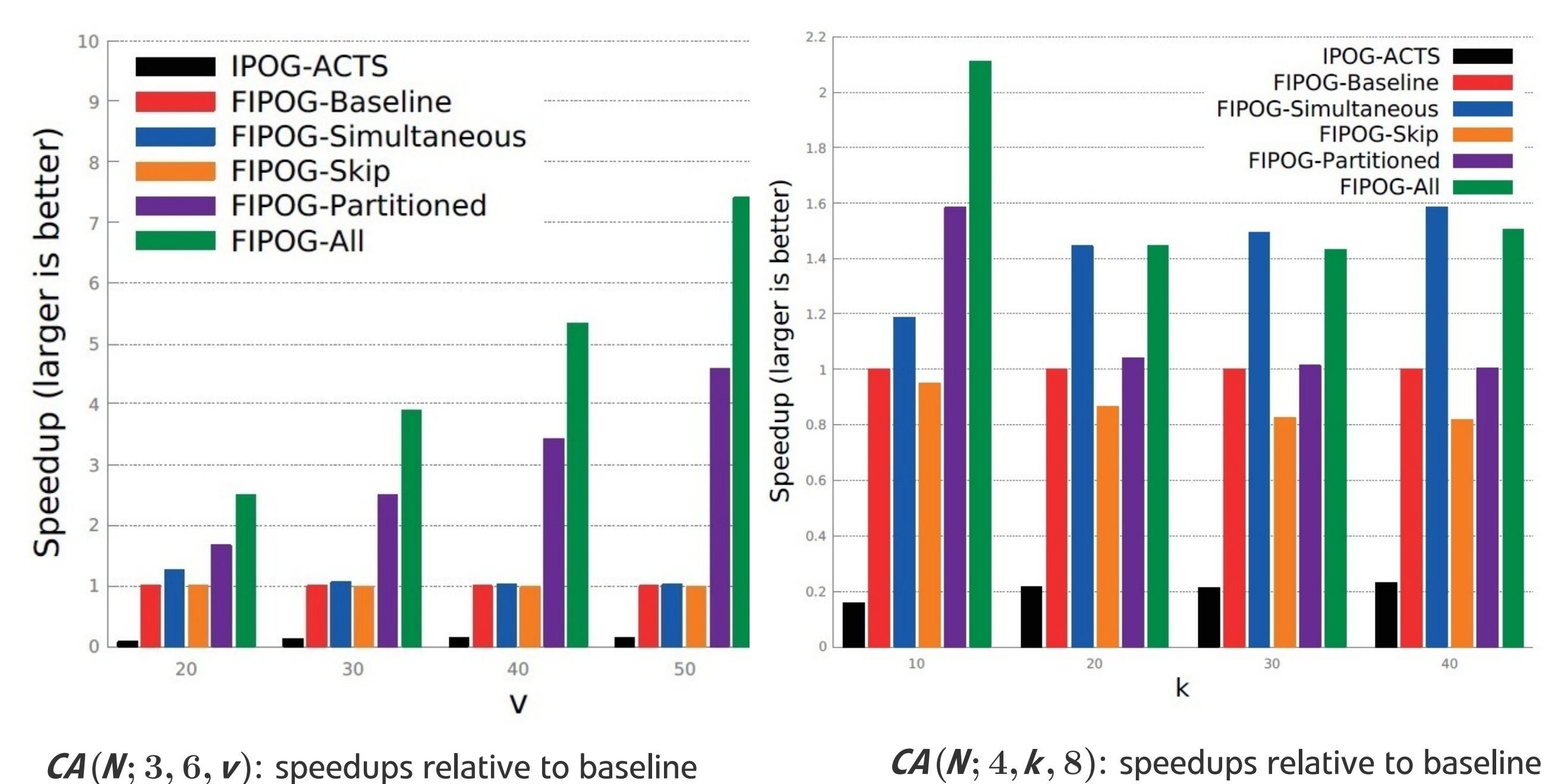
W_1	W_2	W_{k-1}	W_k
		$(S_i)_{i=1}^k \times \mathcal{M}$		
			
T_1	T_2	T_{k-1}	T_k
***			***	***

Set based approaches (IFS)

- ▶ **Goal:** Generation of small CAs
- ▶ **Idea:** Enforce balancing properties to prune search space
- ▶ **Methodology:** Coverage property equivalent to intersection property of set system
- ▶ **Real-World Challenges:** Runtime
- ▶ **Implementation:** λ Haskell

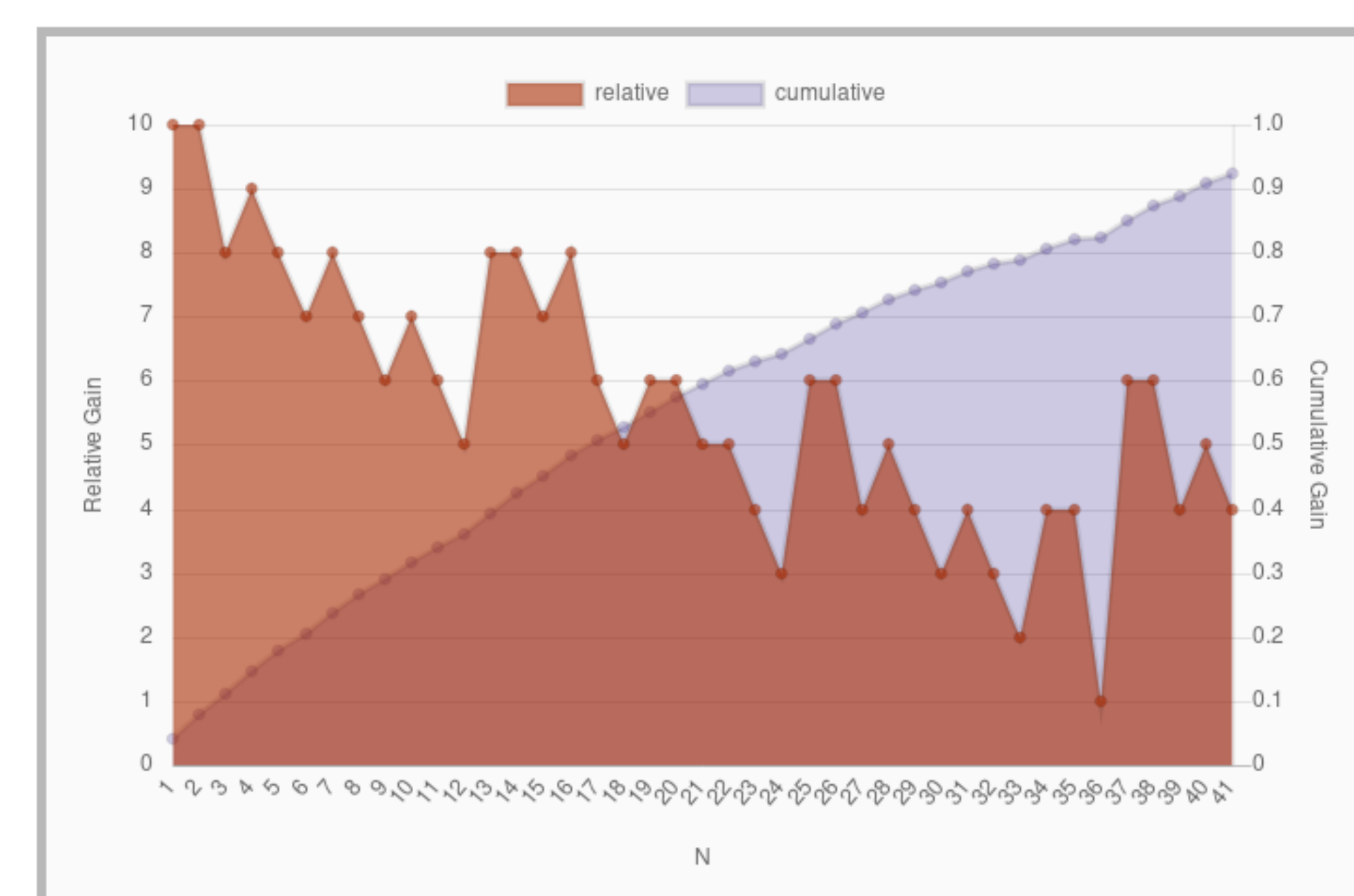
Fast In-Parameter-Order Algorithm – FIPO

- ▶ **Focus:** Efficient implementation of the IPOG algorithm
 - ▷ **Result:** Orders of magnitude faster CA generation
- ▶ **Optimization:** Separate improvements to existing algorithm
- ▶ **Modelling:** Two dimensional growth of CAs until complete
- ▶ **Implementation:** Rust
 - ▷ **FIPO tool:** Publicly available soon



ACATS – Tool

- ▶ **Motivation:** Provide a tool for combinatorial analysis for test suites
- ▶ **Advantages:**
 - ▷ Offers more features than existing tools
 - ▷ Offers analysis tuned for performance or memory usage
 - ▷ Web UI and command line interface



Selected Research Collaborators



Research Institute for
Symbolic Computation



Computer Algebra Research Group



Wilfrid Laurier University