

A Model-driven development framework for highly Parallel and EneRgy-Efficient computation supporting multi-criteria optimisation

Addressing Time Predictability in AMPERE

AMPERE Final Event Webinar

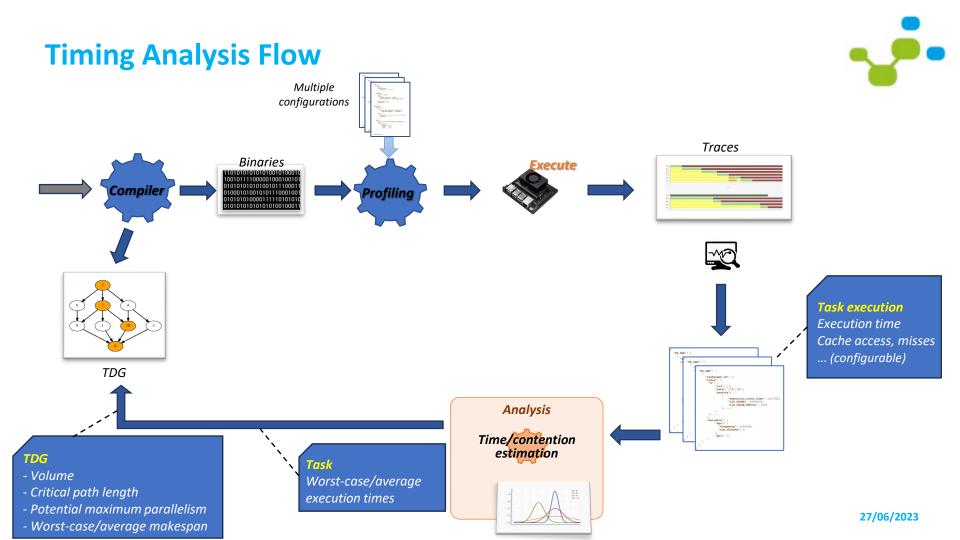
Luis Miguel Pinho — ISEP 27 June 2023



The AMPERE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871669

AMPERE ecosystem workflow Off-line multi-criteria **TDG** augmentation PCC **ODAS** optimization based on the TDG: • Performance System description: • Components/comms. Heterogeneity Capella Functional/NFP Time-predictability Capella to Energy efficiency Amalthea bridge Amalthea Resiliency TDG generation Meta MDE Meta PPM **(MP** abstraction abstraction Model Heterogeneity **Code Synthesis** Compiler Time-predictability Xillinx Zyng Correctness + **OpenMP** source Energy efficiency TDG generation Parallel code Resiliency code generation **ZCU102** (OpenMP, CUDA DART LLVM APP4MC graph, FRED tasks) **NVIDIA OS+Hypervisor** Perf Jetson AGX **ERIKA** Execution profile PikeOS Linux

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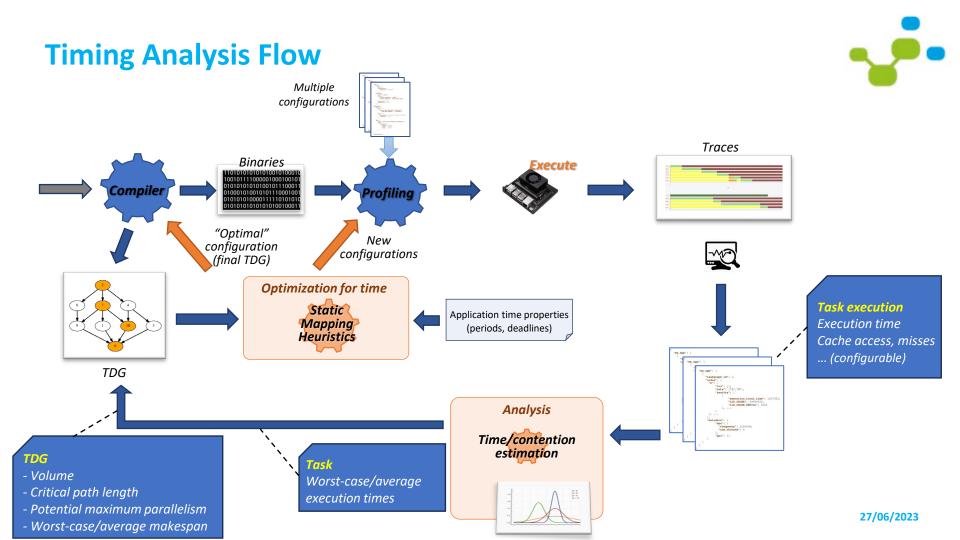
Timing Analysis



Some numbers of the use cases

Use Case	Task	Runnable	WCET (us)	AVG_Time (us)	
ODAS	RADAR Processing	RADAR spatial synchronization	2 585	541	
РСС	Perception ACC	T100_ms	7 140	2 449	

Use Case	Task	Volume (us)	Worst case Makespan (us)	Average Makespan (us)	Max Parallelism
ODAS	RADAR Processing	42 000	11 199	3 008	3
PCC	Perception ACC	5 863 416	615 548	364 877	29

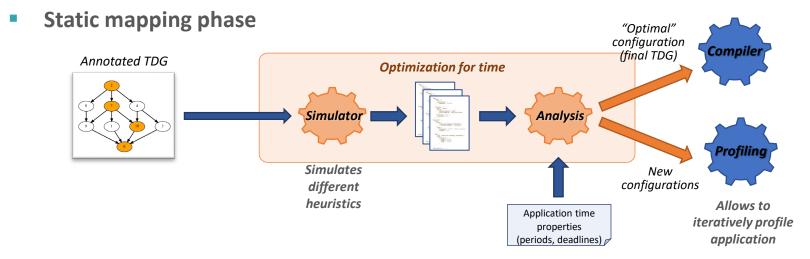


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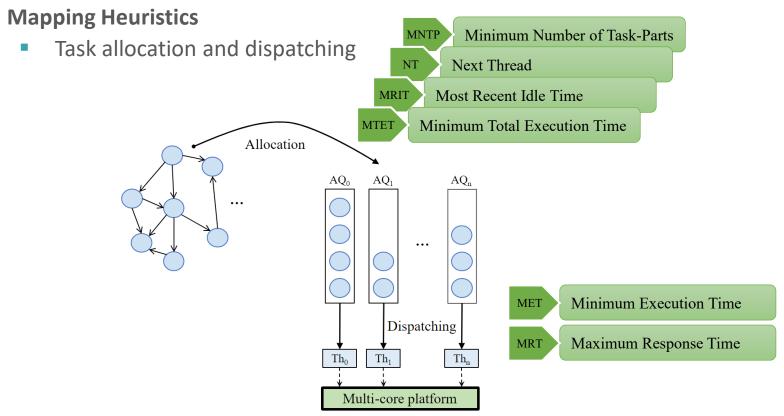


- Add "staticness" to the execution to allow for
 - Less execution time variability
 - Less analysis pessimism



Static Mapping





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Manning Houristics	

iviapping neuristics

Static Mapping

- Different heuristics provide better results for different benchmarks
- But the MTET-MET combination is usually dominant
 - "Static" load balancing

System		Tied Tasks			Untied Tasks		
Model	BFS	WFS	LNSNL	BFS	WFS	LNSNL	
1-level nested tasks	-4.03%	55.99%	-0.19%	-3.64%	39.21%	33.66%	Main focus
2-level nested tasks	20.13%	87.67%	37.29%	18.77%	43.81%	49.62%	Ivialit locus
n-level nested tasks	19.88%	88.64%	49.06%	23.19%	47.49%	67.01%	
Average	11.99%	77.43%	28.72%	12.77%	43.50%	50.10%	



Dynamic: LLVM work-stealing Spread: if possible, no sharing of L2 Close: sharing of L2 by 2 threads

Dynamic mapping

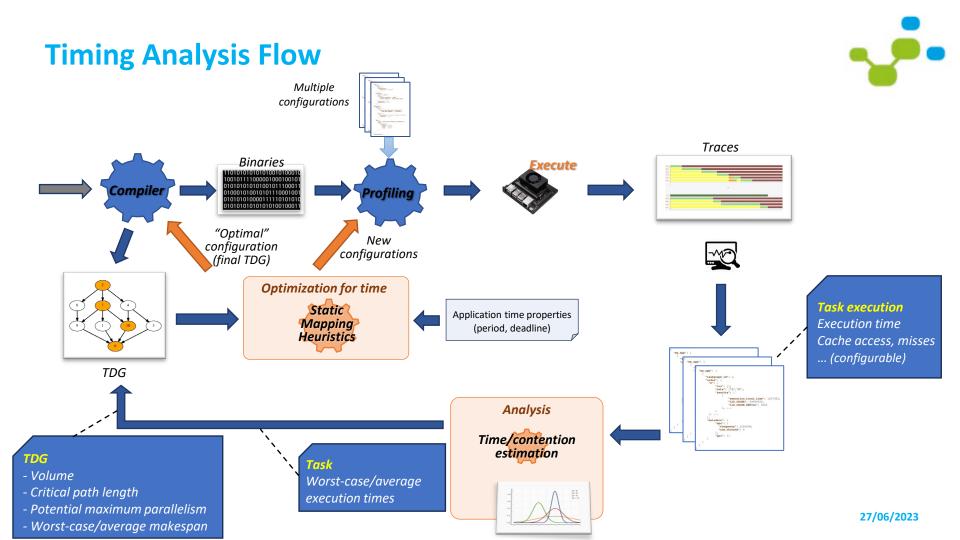
6 Response time (s) 5 4 3 2 0 Dynamic A spread spread spread A spread A spread A spread Spread

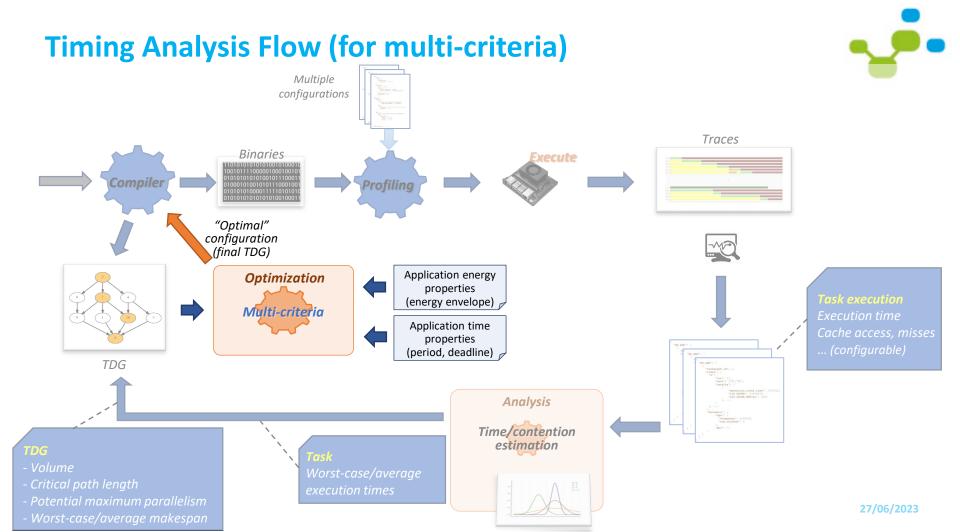
Two heuristics have also been implemented for runtime mapping

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Thank you!

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