

DMT-extraction: A FOSS Python framework for parameter extraction showcased by a PSP extraction workflow

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Outline

- Motivation and introduction
- DMT-core
- DMT-extraction
- IHP OpenPDK automated measurement documentation
- PSP extraction status

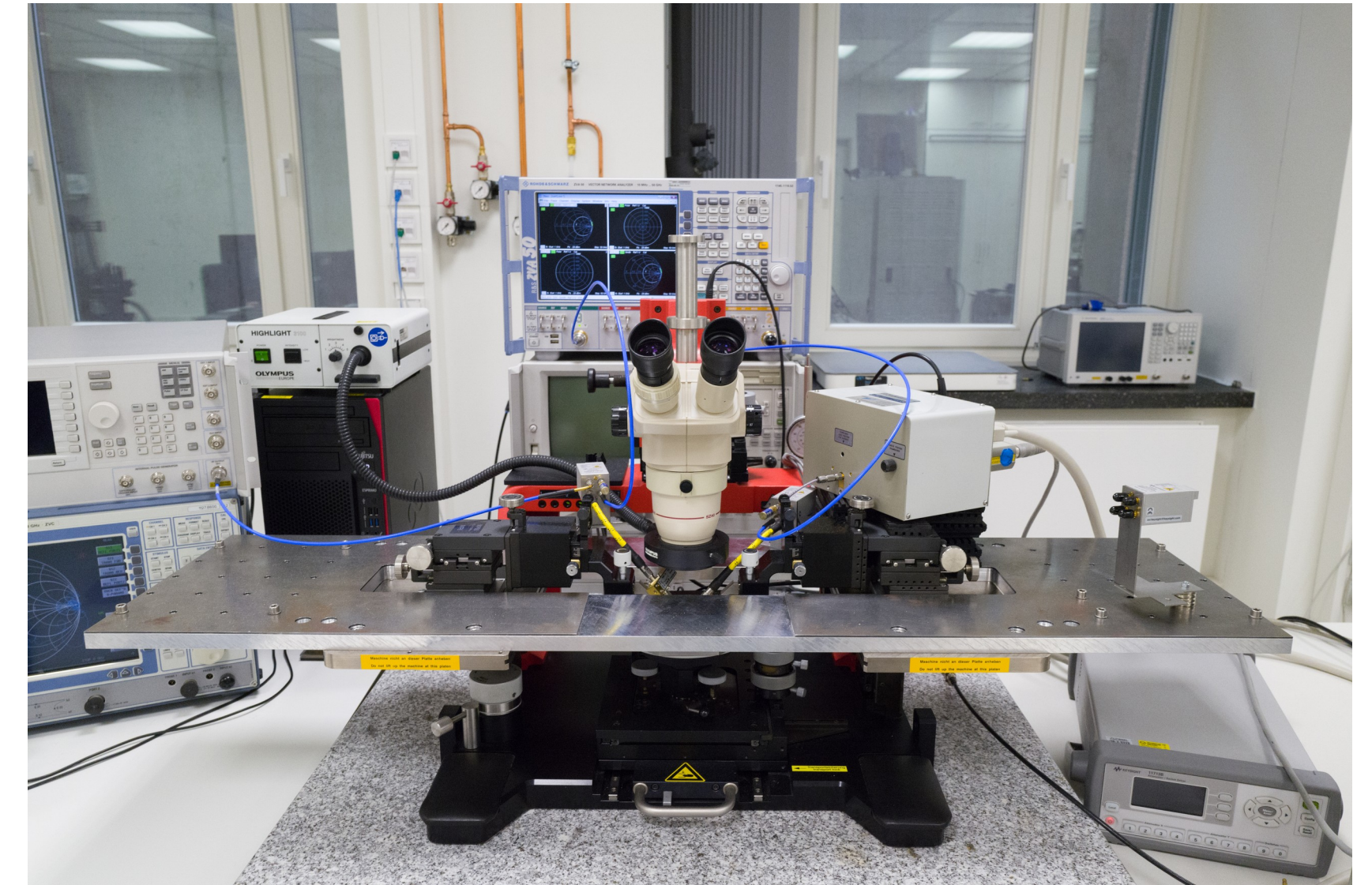
Motivation and introduction

Tasks faced by device/modeling engineers:

- interfacing measurement equipment
- dealing with large quantities of data
- using mathematical optimization
- dealing with complicated model equations
- interfacing circuit/TCAD simulators
- documentation of extraction results
- sharing of extraction (single steps or full flows)
not common currently

► These are mostly software and infrastructure problems!

► Everyone solves some of these problems for himself once in his work life!



Comparison: Proprietary tool vs. in-house

Finished extraction environment

- Fast to get some results
- Results might be questionable
- Significant license cost
- Connects to different measurement setups
- Extraction flow hidden or intransparent

Writing your own environment

- Slow to get started
- Time cost
- Usually only connects to current measurement setup
- Enables deep look into extraction flow

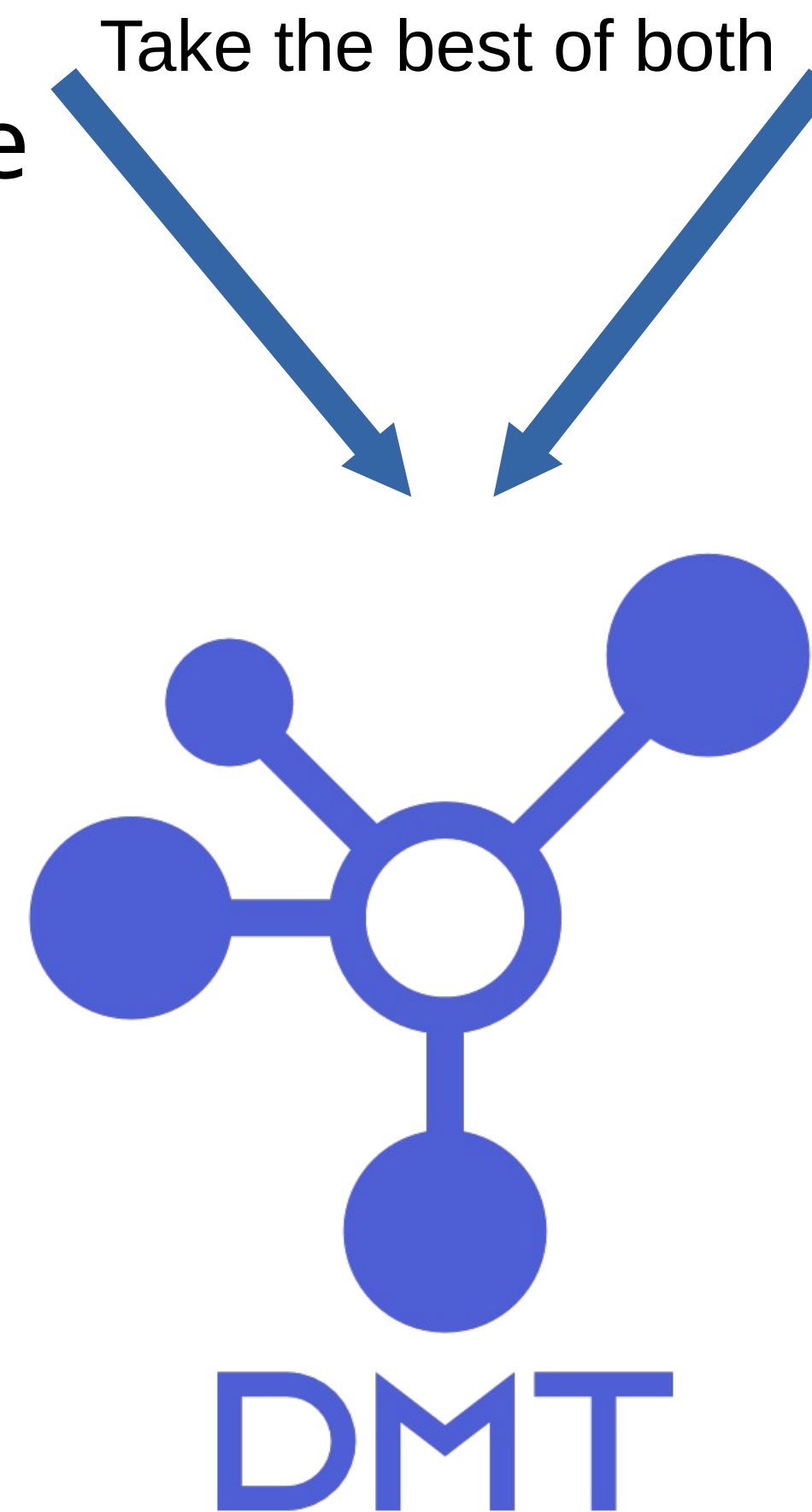
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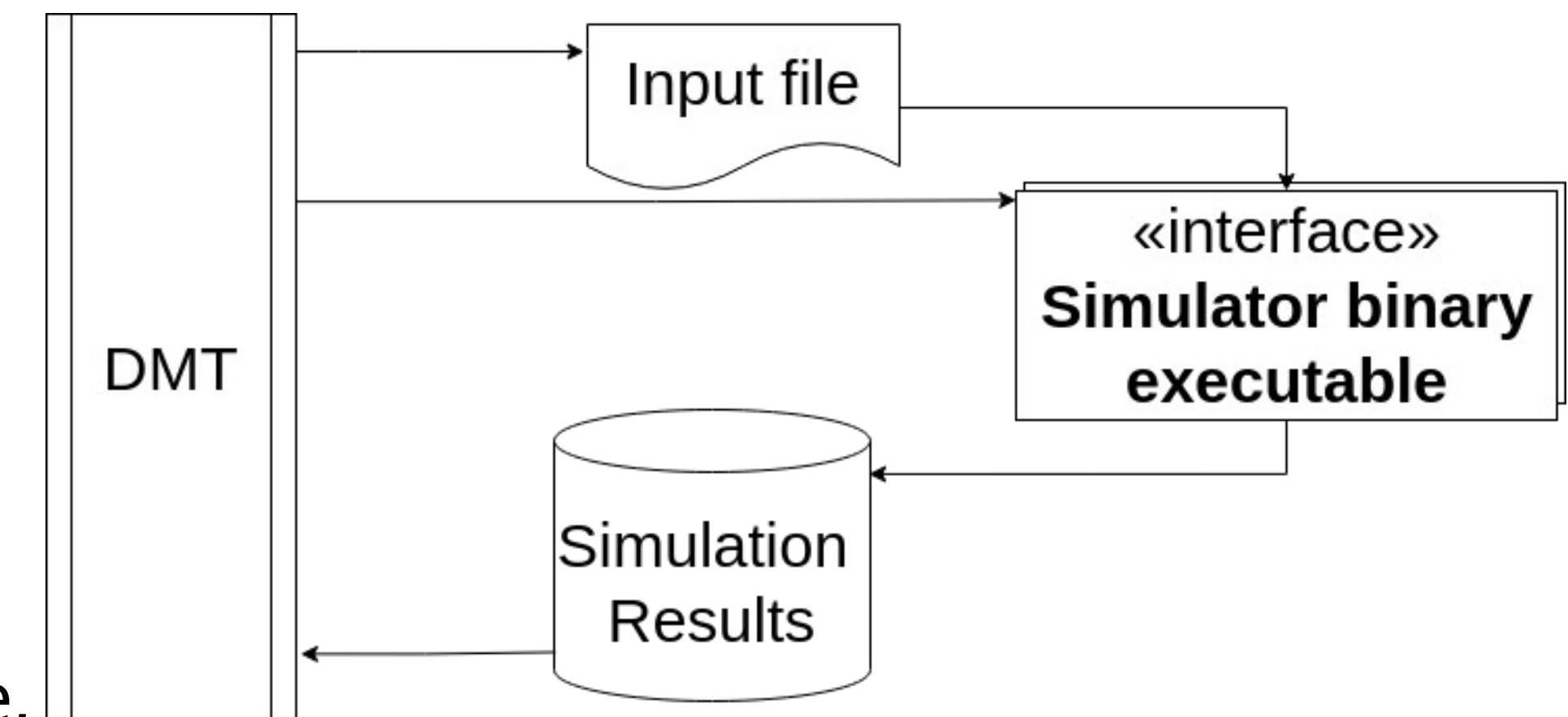
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DMT-core

Already existing DMT-core[1] module provides:

- routines for bulk measurement read-in, including documentation
- interface template for circuit simulators, implemented for ngspice and others
- a simulation controller class for parallel and/or remote simulations
- standardized way to save/load and plot data
- modelcard management based on Verilog-AMS source codes
- deep view into data flow as it is open-source

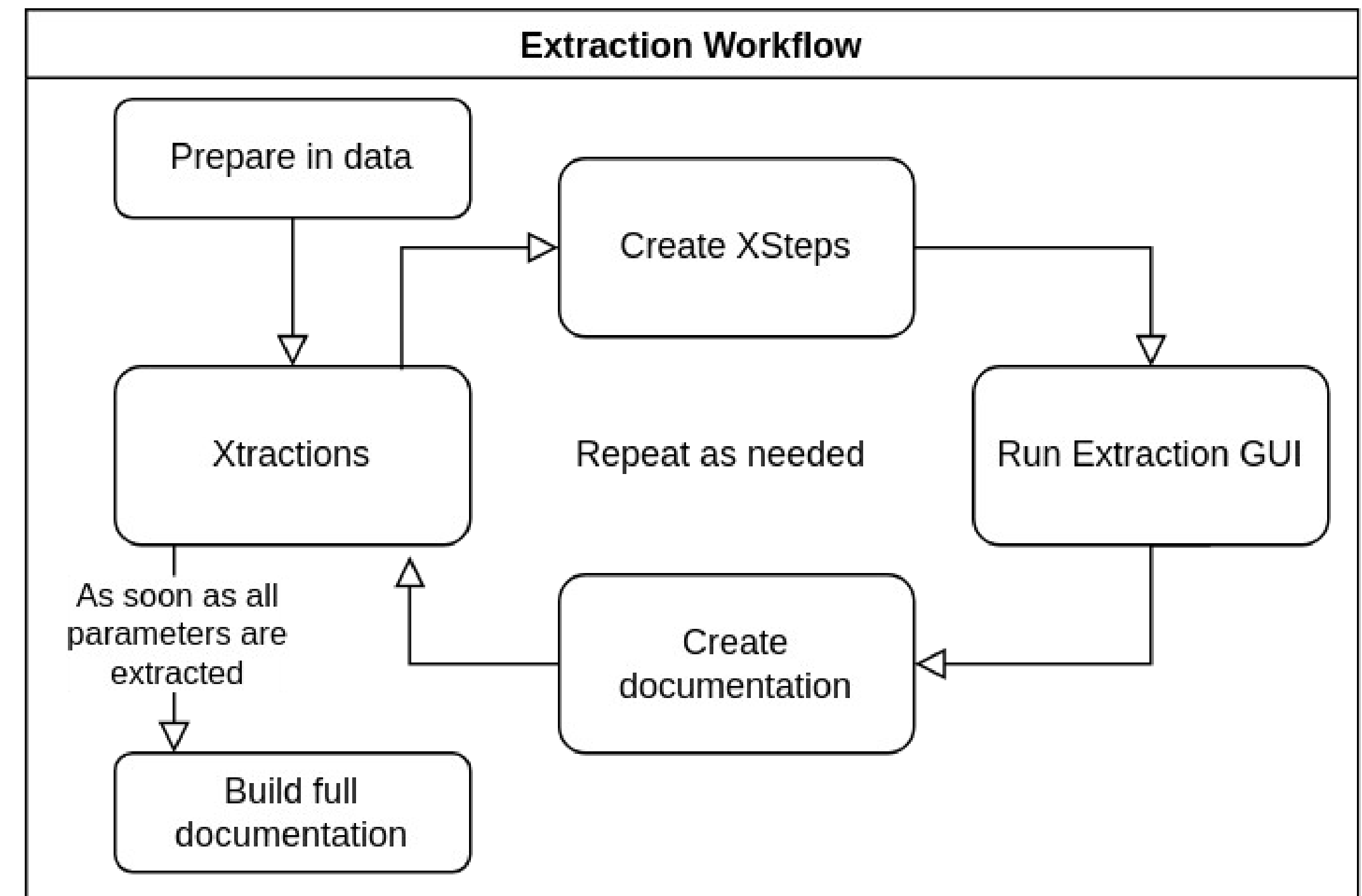


[1] Krattenmacher et al., (2022). DMT-core: A Python Toolkit for Semiconductor Device Engineers. Journal of Open Source Software, 7(75), 4298, <https://doi.org/10.21105/joss.04298>

DMT-extraction

We are funded by Nlnet[2] for developing an open-source extraction framework for MOSFET extraction. This includes:

- extraction step template and surrounding infrastructure
- extraction management and documentation
- a graphical user interface (GUI)
- a MOSFET extraction workflow implemented for one example measurement



[2] <https://nlnet.nl/project/DMT-Core/>

DMT extraction project

The project was split up into 5 parts:

1. Generic coding tasks and preparation
2. MOSFET parameter extraction implementation for single transistor geometry (finished this milestone last week)
3. MOSFET parameter extraction implementation for scalable geometry
4. Obtain measurement data from real technology => Target IHP SG13G2
5. Parameter extraction based on real data

The project is available on <https://gitlab.com/dmt-development/dmt-extraction>

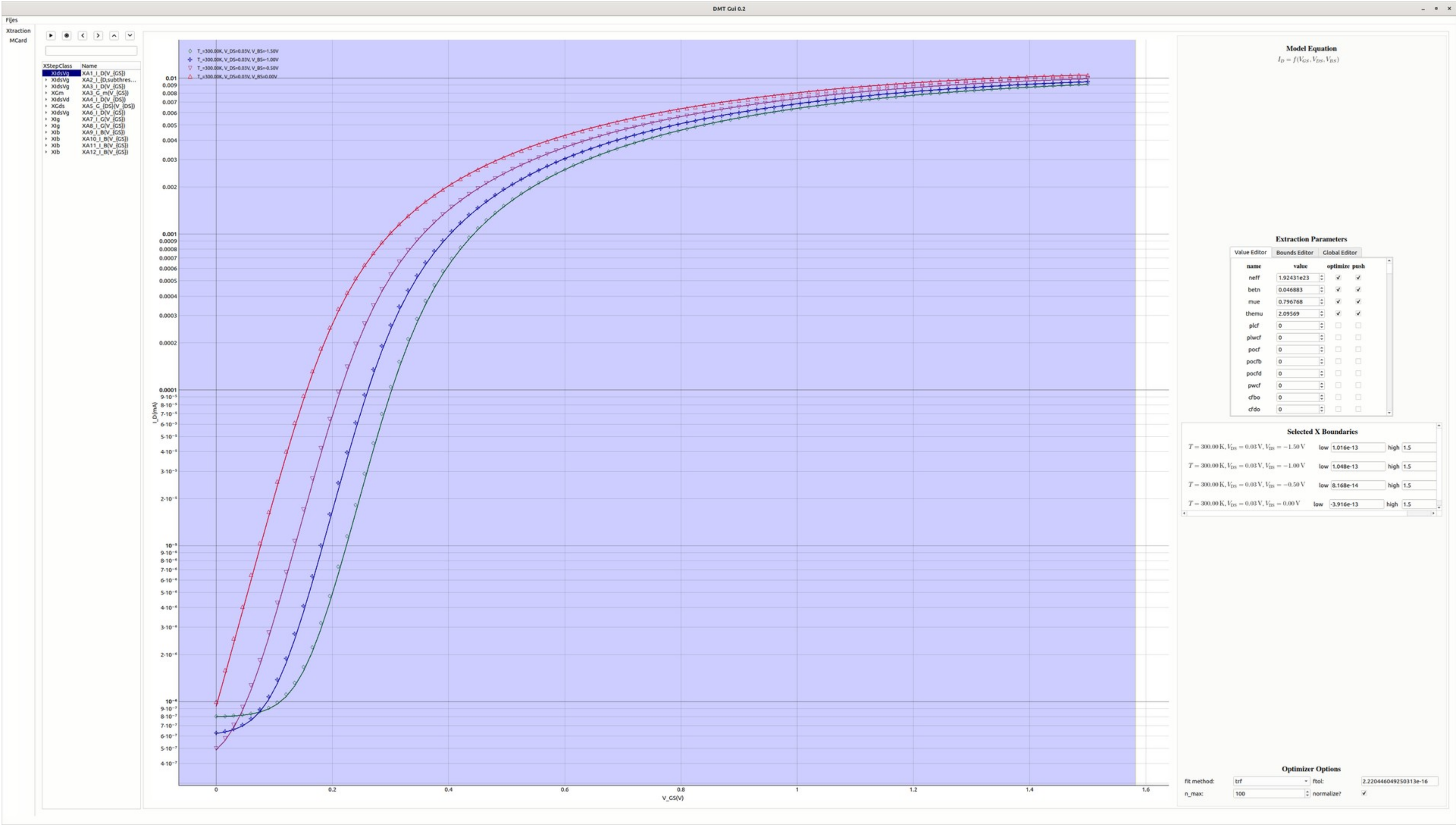
IHP OpenPDK measurement documentation

- IHP openPDK project:
<https://github.com/IHP-GmbH/IHP-Open-PDK>
- Full open-source PDK including tool-chain projects
- Semimod...
 - ... prepared and verified the MOSFET and HBT models for Xyce and ngspice:
https://gitlab.com/dmt-development/ihp_sg13g2_compact_models
 - ... generated a measurement report for the measurements in the OpenPDK:
http://files.semimod.de/IHP_openPDK_model_vs_measurement.pdf

PDK Contents

- Base cellset with limited set of standard logic cells
 - CDL
 - GDSII
 - LEF, Tech LEF
 - SPICE Netlist
 - Liberty
 - Verilog
- SRAM cellset
 - GDSII
- Primitive devices
 - GDSII
- KLayout layer property and tech files
- Pcells (limited set, for reference only)
- HSPICE Models of HBT devices
- OpenEMS: tutorials, scripts, documentation
- SG13G2 Process specification
- SG13G2 Layout Rules
- MOS/HBT Measurements in MDM format
- Project Roadmap Gantt chart

PSP extraction status



Thank you

Special thanks to

- Nlnet foundation
- Prof. Schröter
- Dr. René Scholz and IHP
- Dr. Gregory U'Ren and XFAB

Do you have feature requests?

View our project on <https://gitlab.com/dmt-development/dmt-extraction>

Directly file an feature request using

https://gitlab.com/dmt-development/dmt-extraction/-/issues/new?issuable_template=feature_request