Automated Project Setup using COSIDE® Scripting

Alexandra Küster
Engineering System Architecture Inertial Sensors (BST/EAP1)
Bosch Sensortec GmbH

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Öffentlich C-SC0

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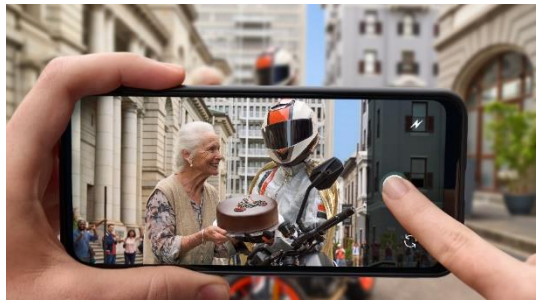
MEMS sensing solutions
The enablers for CE and IoT applications



Smartphones

Hearables

Wearables

AR/VR Glasses & Headsets

Laptops & Tablets

Robots & Drones

Gaming & TV

IoT, Whitegoods, Smart Home

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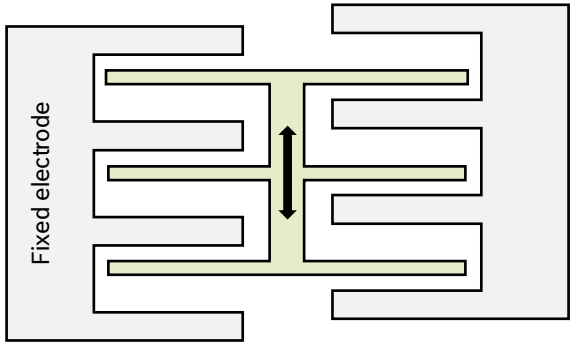
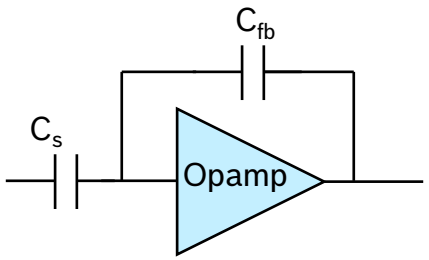
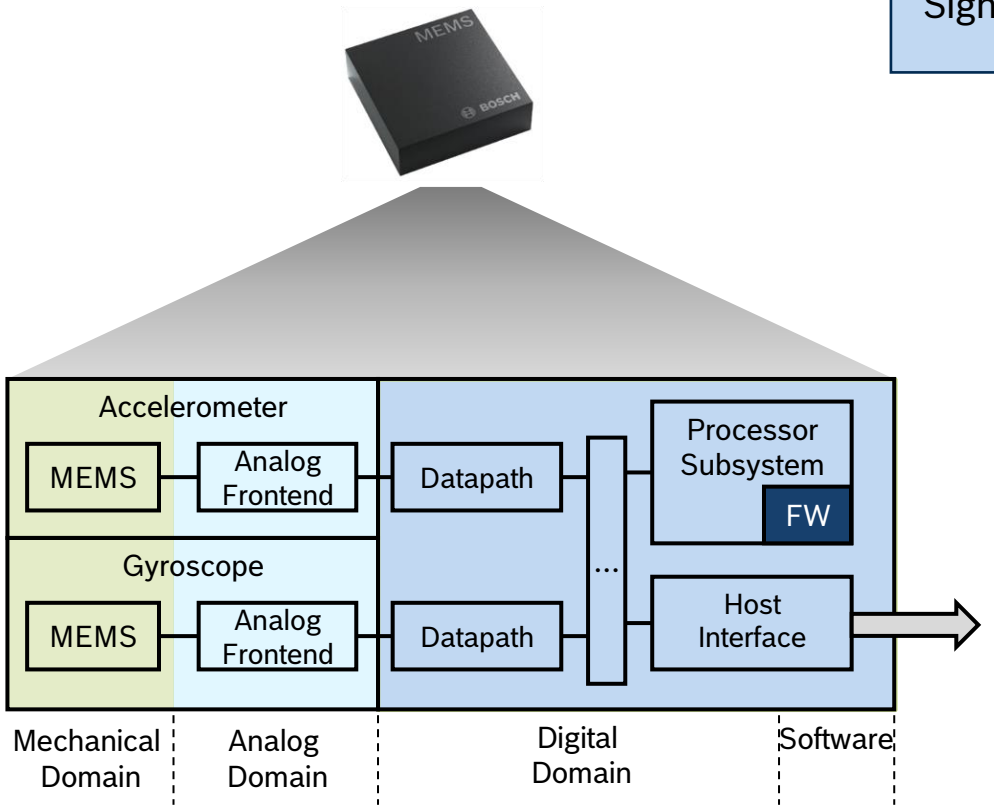
Motivation
Virtual Prototyping for MEMS Sensors

Acceleration → Capacity

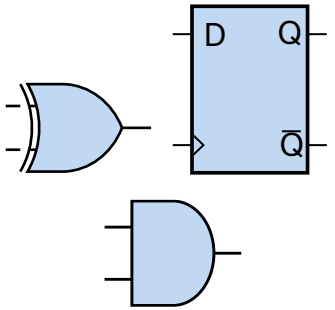




Capacity → Analog Voltage → Digital Signal



Signal processing, configurability, host interaction



Self-calibration, sensorfusion, algorithms (e.g. step counter)

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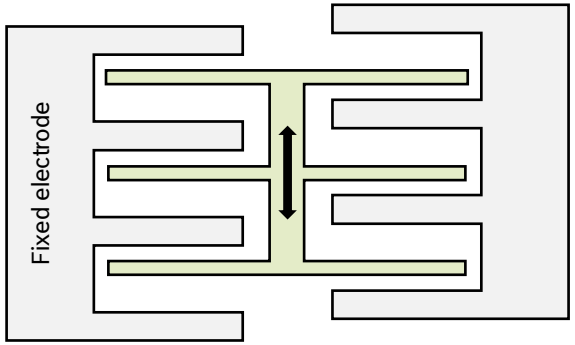
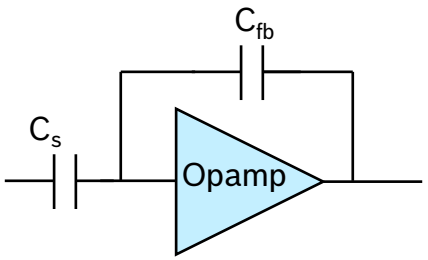
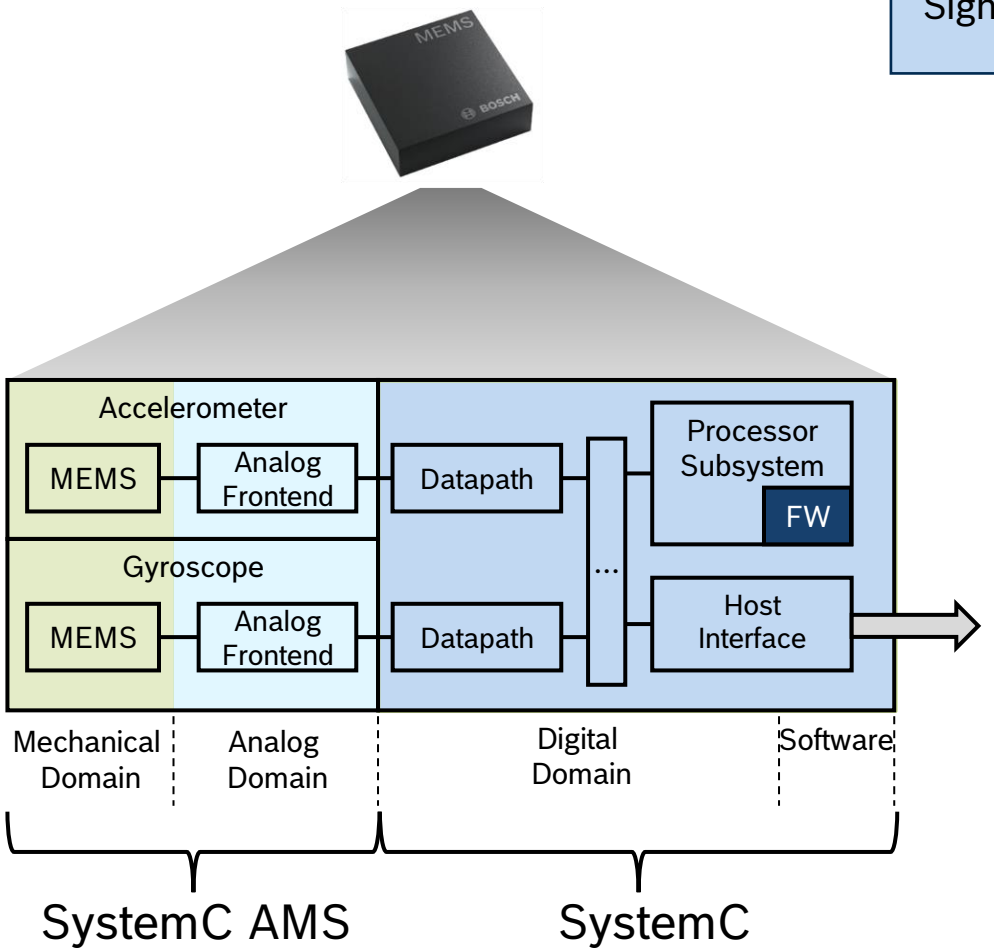
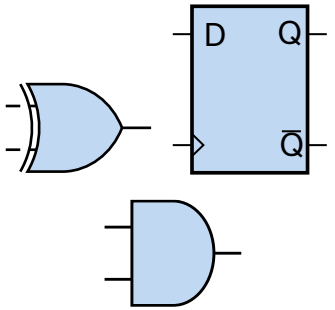






Signal processing, configurability, host interaction



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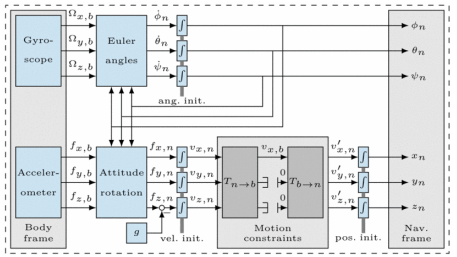
Motivation
Lifecycle of a Virtual Prototype

Design Space Exploration (DSE)	Executable specification	Virtual prototype for FW Development & Verification	Frontloading of driver and customer FW development External customer models
▪ Explore new concepts ▪ HW/SW partitioning ▪ Choice of µC	▪ Validation of spec. ▪ Find gaps/issues in concepts early	▪ Develop and debug FW before HW is ready ▪ Enables exhaustive testing & validation	▪ Same connectivity as real HW ▪ Virtual Prototype as deliverable



VPs are developed and maintained throughout the entire development process

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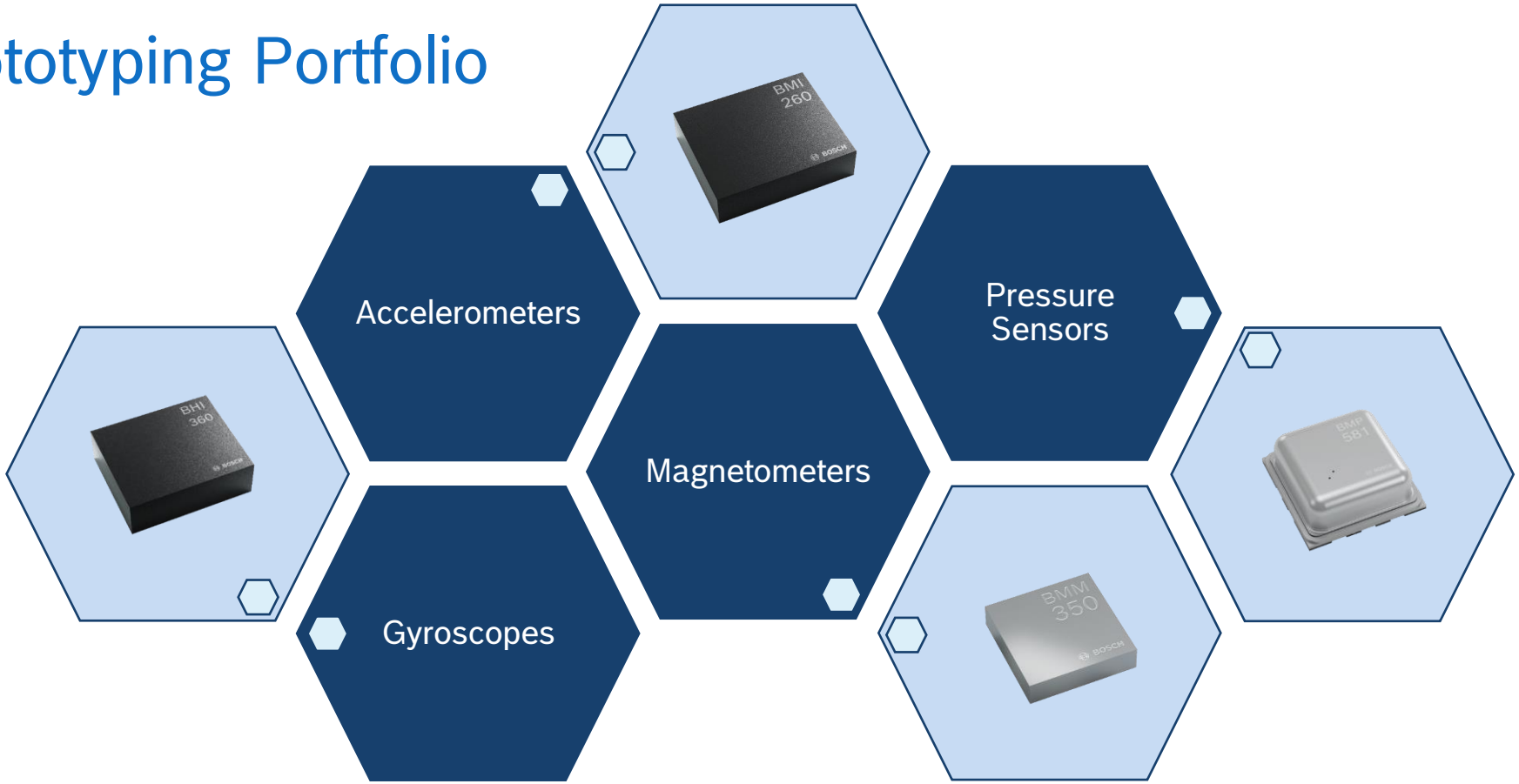
Motivation
Virtual Prototyping Portfolio



Broad range of products use virtual prototyping

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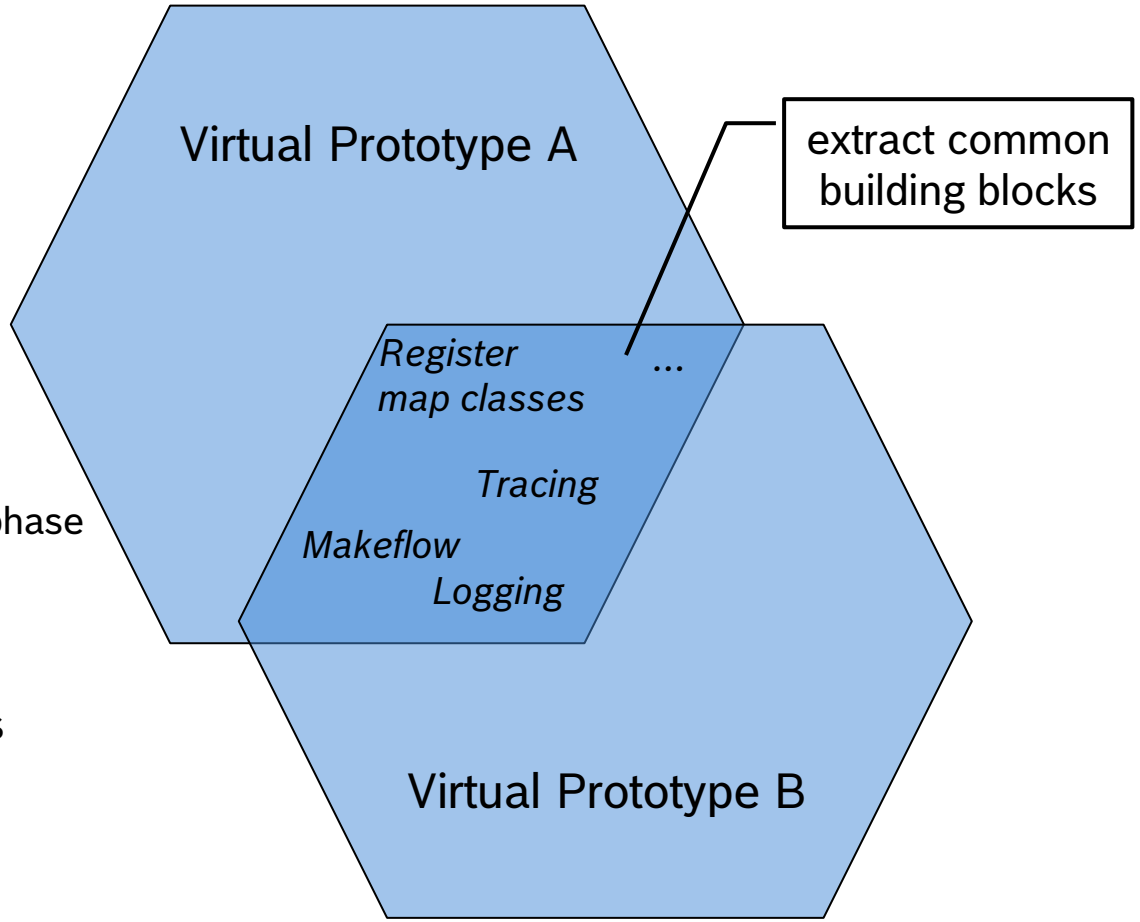
Motivation
Scalability and Reuse

- Former:
  - New projects started with some manual copies from previous ones
  - Bugfixes and improvements were manually shadowed to other projects
    - Or not at all for projects after main development phase
- New:
  - Each project starts from common template
  - Extraction of project independent building blocks
  - Faster reuse and automated update mechanism
    - Less maintenance effort
  - Easier onboarding for new associates



Target: Increase scalability by faster reuse and maintenance

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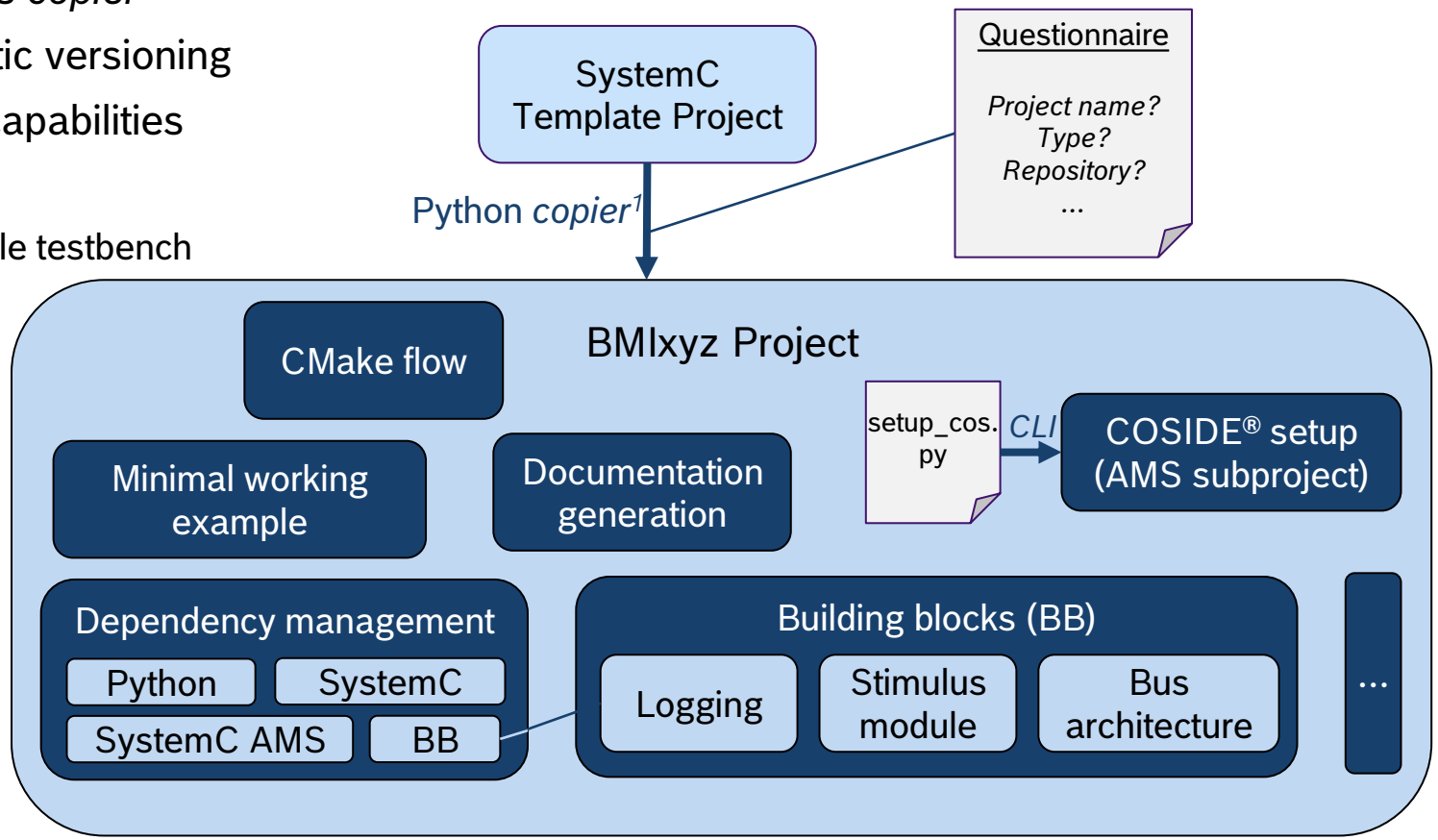
Implementation
Starting a new project

- Initial copy using Python package *copier*
- Each building block uses semantic versioning
- COSIDE® setup using scripting capabilities
- Minimal working example
  - including toplevel and executable testbench
- Prepares development flow
  - CMake
  - Documentation generation
  - Continuous integration



[1] https://github.com/copier-org/copier

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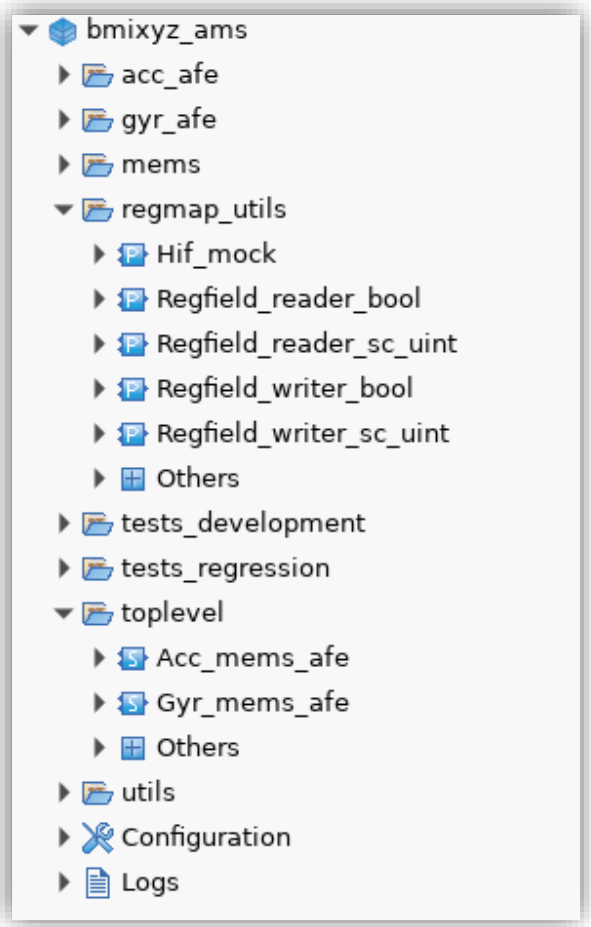
Implementation
Coside Scripting: Project setup

Create project	*cos.create_project('bmixyz_ams')*
Set configuration	*my_project.set_config_data_var('SC_INCLUDE_FX', 'yes')*
Add libraries (w/ description)	*lib_mems = my_project.create_library('mems')* *overwrite_library_description(lib_mems, 'Mechanical modules')*
Setup register map utilities	*init_regs(lib_reg)*
Sensor specific setup	*init_imu()*
Create toplevel dummies	*module_top = lib_top.create_schematic(sensor+'_mems_afe')*



Create standardized look and feel for all projects

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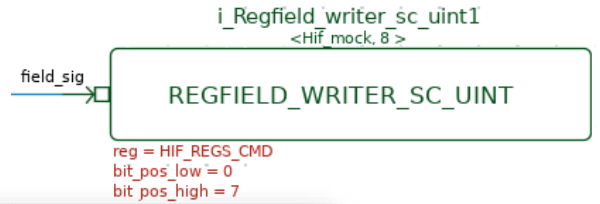
Implementation
Coside Scripting: Register map utilities



- Create module
- Add templates
- Add port
- Add parameters
- Add sc_method with sensitivity
- Save
- Implement sc_method

```
#######################################################
# writer for register fields of type bool from sc_signal
#######################################################
reg_write_sc_uint = lib_reg.create_sc_module('Regfield_writer_sc_uint')

reg_write_sc_uint.add_template('REG_MOCK', 'Example_mock', 'typename')
reg_write_sc_uint.add_template('N', '8', 'int')

reg_write_sc_uint.add_port('field_sig', 'sc_core::sc_in<sc_uint<N>>', 'signal to write field from')

reg_write_sc_uint.add_parameter('reg', 'int', '0', 'register to write to')
reg_write_sc_uint.add_parameter('bit_pos_low', 'unsigned int', '0', 'lowest bit position of field within register')
reg_write_sc_uint.add_parameter('bit_pos_high', 'unsigned int', '1', 'highest bit position of field within register')

reg_write_sc_uint.set_no_coside_dependency(True)
wr_method = reg_write_sc_uint.add_sc_method('write_reg', 'write to register field')
wr_method.set_sensitivity(['field_sig'])
reg_write_sc_uint.save()

wr_method_loc = str(Path(lib_reg.location) / f"{reg_write_sc_uint.name}.cpp")
new_wr_method_loc = wr_method_loc.split('.',1)[0]+str('.hpp')
os.rename(wr_method_loc, new_wr_method_loc)
implement_function(new_wr_method_loc, reg_write_bool.name, 'write_reg',
"""\t// implementation
sc_lv<32> temp_val = s.reg_r.read(); // Read the current value
temp_val.range(p.bit_pos_high, p.bit_pos_low) = reg_sig.read(); // Set the bits from bit_pos_low to bit_pos_high
s.reg_wr.write(temp_val); // Write the updated value back to the signal
""")
```

Scripting keeps template slim

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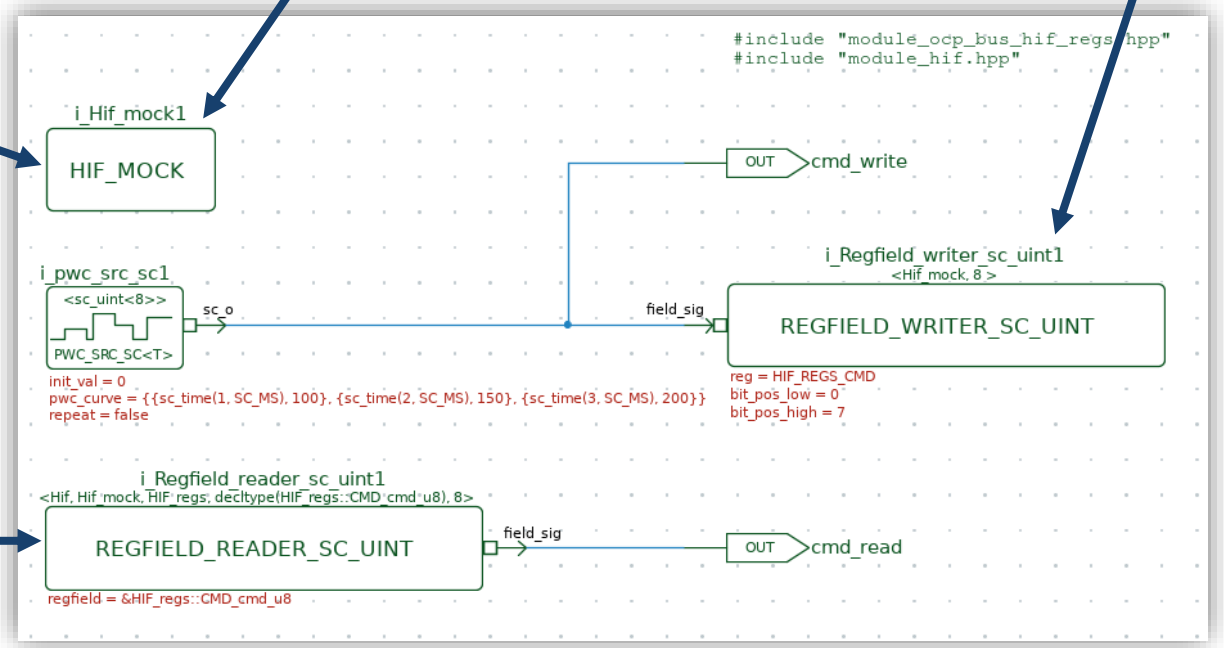
Implementation

Coside scripting: Simple usage example

Instantiates register map of module HIF (for testbenches only)

Mainly used in testbenches to create stimuli

Script for creating a mock lives within Coside → easy creation for new modules during development phase



Used in module schematics to get configurations etc.

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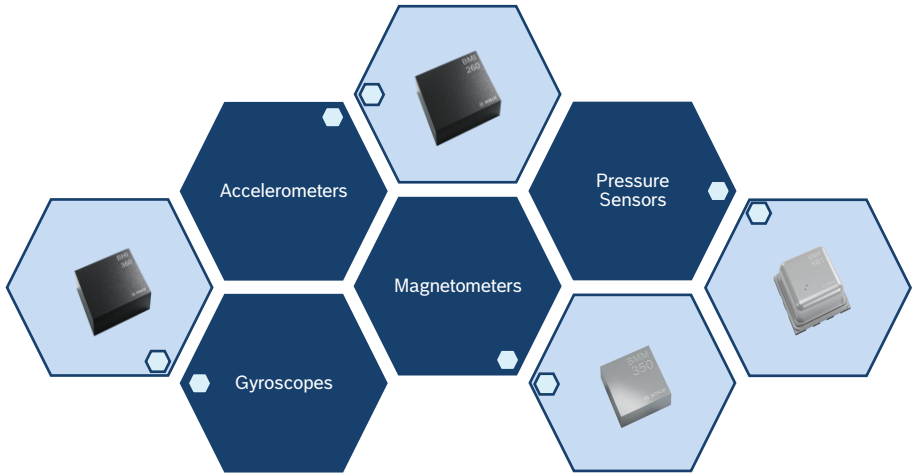
Summary
Automation as Driver for Efficiency

- MEMS sensors are heterogeneous & complex systems
  - ➔ ***Heterogeneous Virtual Prototyping is a key to success***
- Models are maintained for long periods
  - Porting back improvements can create significant effort
- Automation as driver for efficiency
  - Better scalability and traceability
  - Faster spread of improvements
  - Increased homogeneity across models (if you know one, you know all)
- Using COSIDE® scripting capabilities
  - Automated project setup & creation of common modules
  - Transfer of commonly used functionalities (e.g. via post-processing scripts)



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Next Steps
Automation as Driver for Efficiency

- Add custom post-processing to template project
- Automation of test creation
  - Usage of generic testbenches
  - Instantiate toplevel and bind all ports automatically
  - Define naming scheme to make signal accessibility from testcase
  - Register all outputs and dynamic inputs for tracing

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Thank you for your attention

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