Karlsruhe Institute of Technology

Institute for Data Processing and Electronics

A Library to Model and Configure Large Regular Structures in SystemC

Christian Amstutz, Oliver Sander

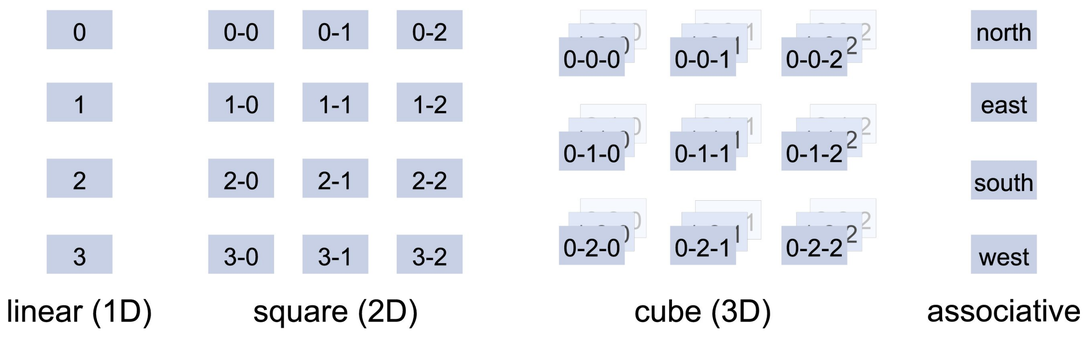
Handle complexity with regular structures

The performance requirements of electronic systems become higher and higher. In recent years the performance gain was mainly achieved by duplicating processing units and arranging them in arrays. Examples are:

- Multi-core processors
- Networks on Chip
- Sensor networks
- Large-scale systems such as the CMS Track Trigger

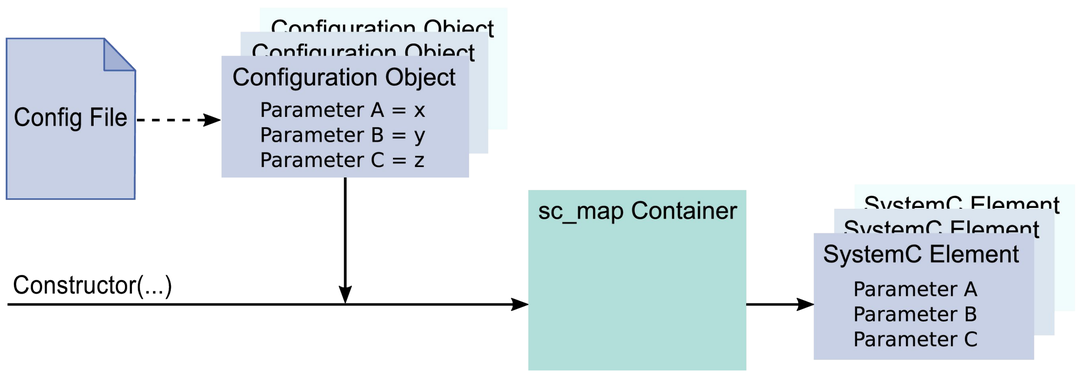
SystemC provides only limited support for the modeling of such regular structures in form of the sc_vector class.

Implemented regular structures



Configuration

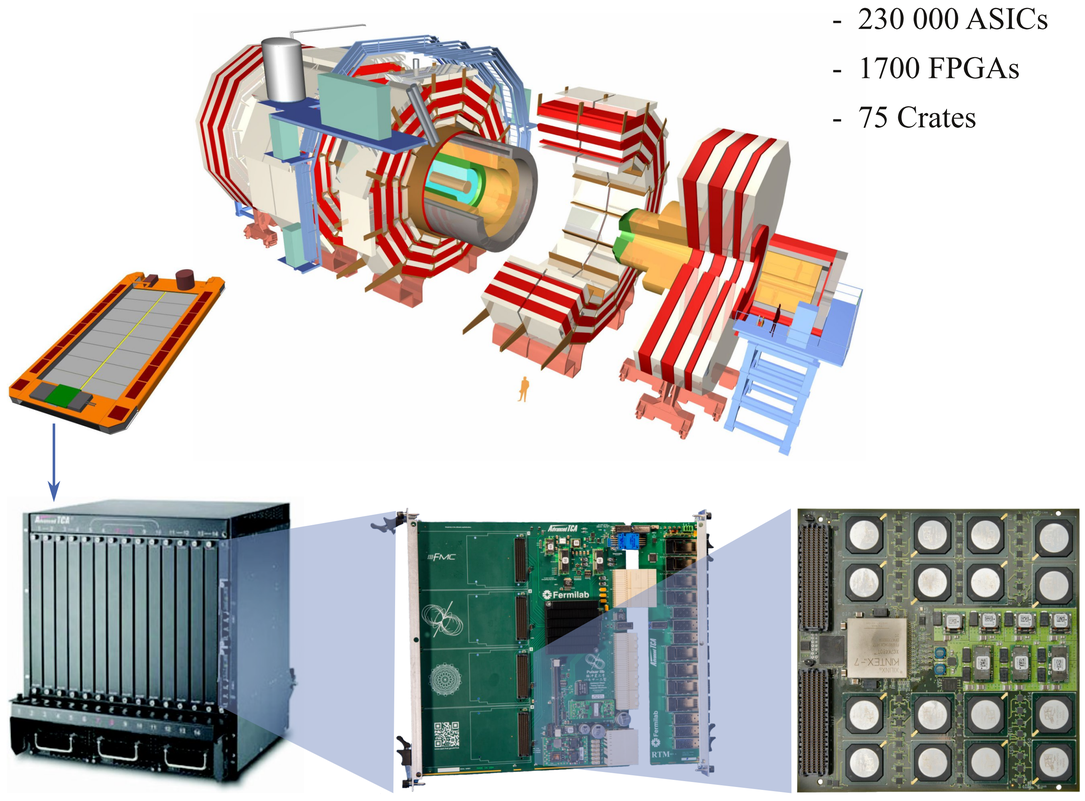
The sc_map library supports the configuration of the objects in the container through the concept of configuration objects. A configuration object has a member for each parameter of the SystemC objects it configures. To configure the objects within an sc_map container, a single one or a set of configuration objects can be passed to the constructor of the container. Hierarchy of a SystemC model is reflected by nesting configuration objects.



The CMS Track Trigger

One of the most extraodrinary digital systems ever built. New data from particle collisions arrive at 40 MHz with a total data rate of 100 Tbit/s. The finding of particle tracks must take less than 4 µs. In total the system consists of:

- 230 000 ASICs
- 1700 FPGAs
- 75 Crates



sc_map — flexible library for regular structures

This gap is filled by the sc_map library. It provides following features:

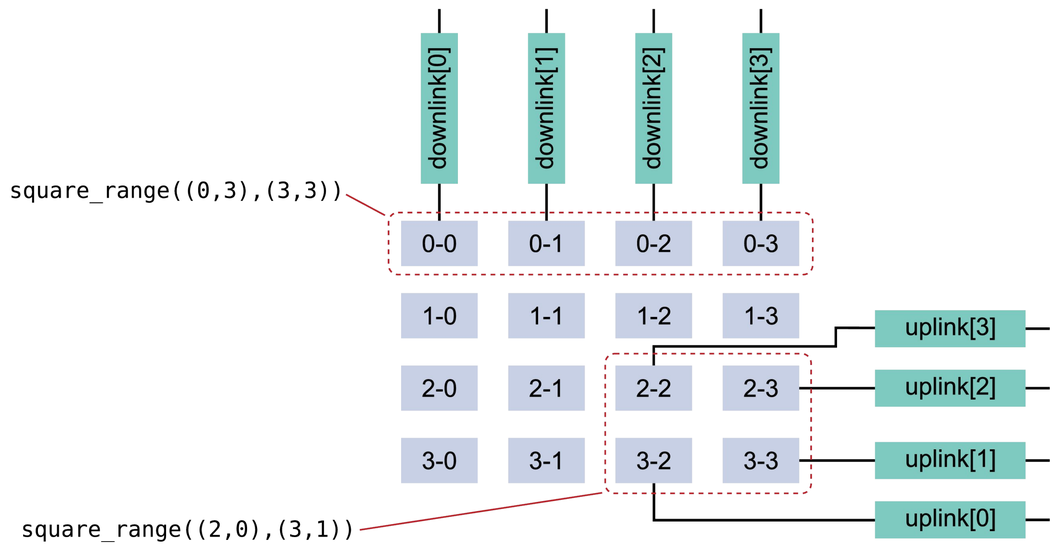
- Modelling included regular structures
- Straightfoward implementation of custom structures
- Selection of parts within a structure—"Slicing"
- Configuration of the SystemC elements within the structure
- Support of SystemC-specific functions, such as:

  sensitivity list, binding, writing to signals

While the code is only executed in the model building phase, the execution of the actual simulation is not affected.

Slicing

The meaning of slicing within sc_map is the selection of a subset of elements from a regular structure. This enables flexible modeling and the change of the number of dimensions along the data flow. Two examples are shown here:

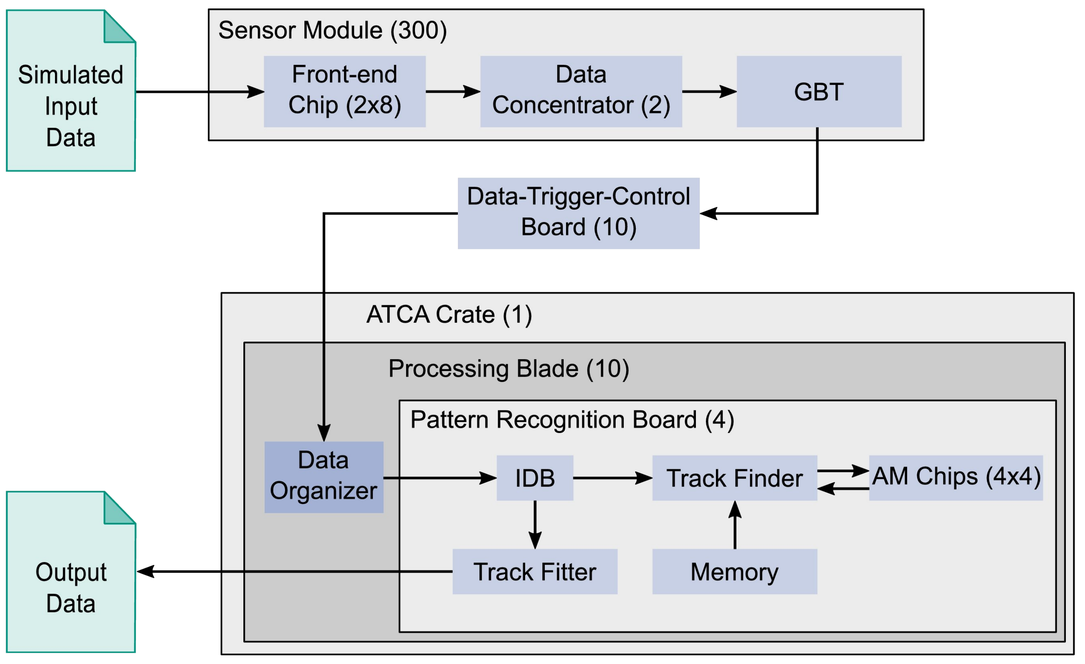


The system-level simulation of the Track Trigger

Many regular structures exist within the CMS Track Trigger system. To facilitate the modeling of these structures, we developed the sc_map library. The system simulation consists of:

- 15 300 sc_map containers
- 122 500 SystemC objects organized within them

The time within the model building phase is only **1.56 s**.



Conclusion

- sc_map facilitates the modeling and configuration of large systems
- Flexible library that covers many aspects of modeling in SystemC
- No time penalty during simulation phase
- Proven useful in the system simulation of the CMS Track Trigger

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