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Seamless integration of the SIMULTAN metadata model in tools using Python

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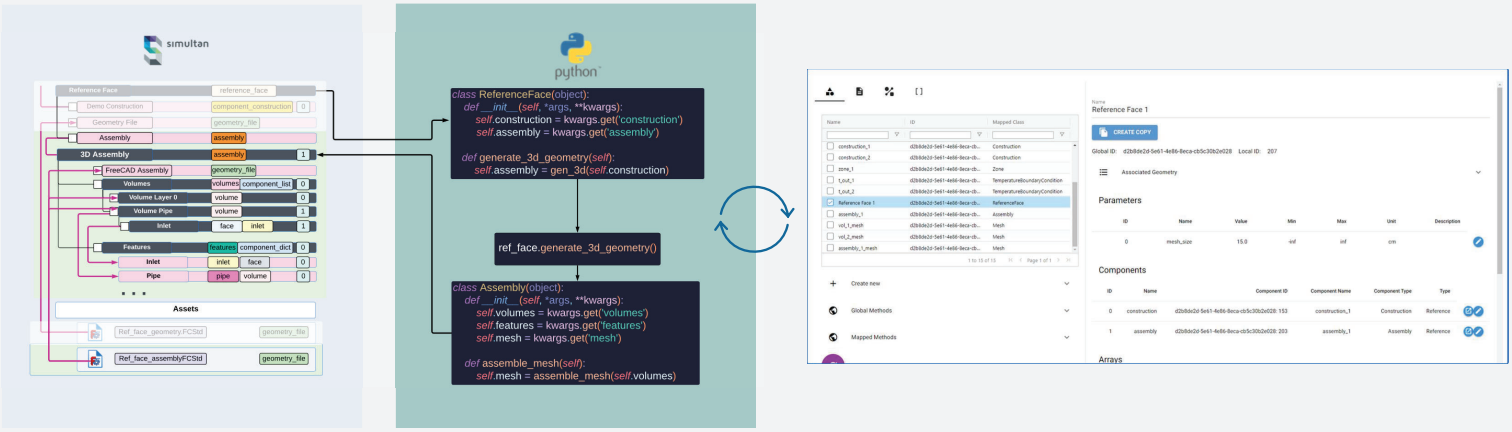

Data model | Library / Tool in PySIMULTAN | Web UI

Fig. 1: Schematic illustration of the integration of the S-MDM in Python with taxonomy-based mapping and the web-interface for maniulation with application specific datamodel-views

Introduction: PySIMULTAN

In the **adoption of digital twins** exists a critical gap in the **integration and maintenance** of simulation models [1]. The SIMULTAN metadata model (S-MDM) is an open-source data model, capable of representing various data and complex structures [2]. Integrating the S-MDM in Python as a universal programming language enables **users to integrate, generate, update and run different simulation models while ensuring consistency and adaptability** to changes throughout the whole lifetime of the building [3].

Integration of SIMULTAN in tools

The PySIMULTAN package has been developed to enable a seamless integration and manipulation of the S-MDM in Python. This is achieved through **taxonomy-based mapping**, which enables the representation of complex data structures as instances of Python classes, similar to traditional ORM tools (Object-Relational Mapping) [3] (Fig. 1).

In addition PySIMULTAN also features an **user-friendly web interface.** This interface facilitates the creation and manipulation of components within application-specific data models views. It also allows for straightforward registration and execution of methods, **enhancing the ease of integration and effective utilization of existing tools and libraries.**

Use Cases

The PySIMULTAN package has been effectively employed to:

- **Automate** the generation, execution, and post-processing of openFOAM models specifically for thermally activated building systems (TABS).
- **Create** models and configurations for **IoT architectures and firmware** for microcontrollers, enabling seamless integration of IoT devices.
- **Conduct shading analyses** through advanced ray-tracing techniques and visualizing the TU library using virtual reality technology.

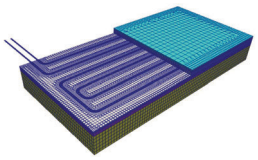

Fig. 2: Automatic openFOAM model generation of TABS

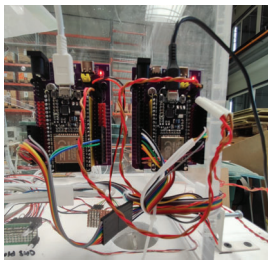

Fig. 3: Digital Twin testbed with from PySIMULTAN generated firmware

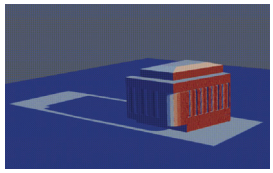

Fig. 3: Shading analysis of the TU library with a SIMULTAN model

Conclusion and Future Work

The use of S-MDM with Python has facilitated the integration of a wide range of tools and libraries. Future work will extend this approach to **include other aspects of building design** and apply relevant **industry standards** to ensure interoperability between tools.

Acknowledgement
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References:
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