A Two-user Framework for Rapid Immersive Assembly-based Product Customization

M. Foursa D. D'angelo G. Wesche

Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS)

The task and its context

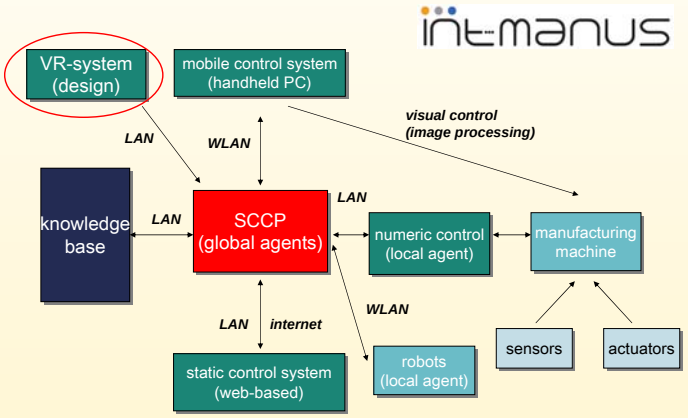
➢ The main purpose of this framework is to allow **the configuration of products from a great number of parts** and transmitting the results to a manufacturing execution system for immediate production.

➢ The framework supports **collaborative work of two users**.

➢ It allows **importing CAD-files** directly into the immersive environment, **creation of new geometry** on the basis of constructive solid geometry (CSG) principles, **attaching virtual connectivity-describing attributes** to parts, **guided assembly** of parts and **comprehensive analysis** of products.

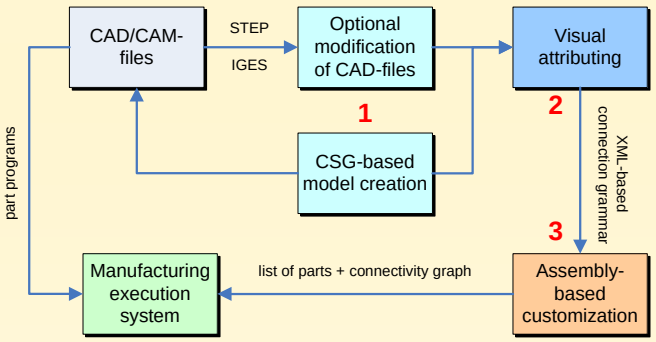
➢ The framework is **directly connected to the Smart-Connected-Control Platform** (SCCP) developed in the context of EU-funded **INT-MANUS** project. The platform allows automatic production rescheduling in response to configuration changes made directly in the customization framework.

➢ The framework may be adapted to any production environment. Since it is based on **AVANGO® VR-framework**, it supports a wide range of display systems and interaction devices.



The customization pipeline

➢ The complete **product customization pipeline** consists of the following stages: 1. import or immersive creation of product parts; 2. visual attributing the parts with connection semantics and 3. interactive assembly of the virtual product from the part set.



Step 1: CSG-based operations

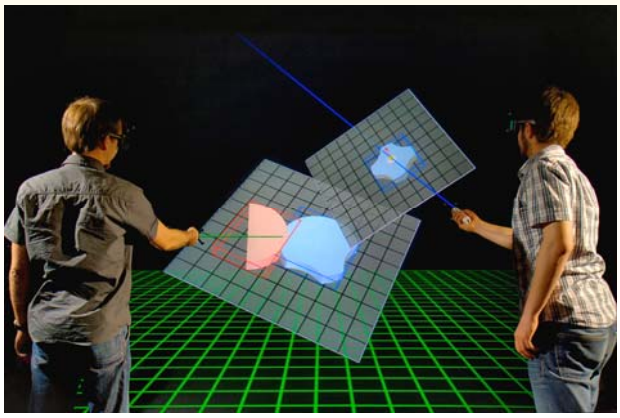
➢Import of standard CAD-formats, such as **STEP or IGES** is supported.

➢ Geometry can be **directly created and modified** in the immersive environment **by applying CSG operations** to geometrical primitives or imported models. The operations hierarchically combine objects on the basis of set operations like union, intersection and difference. The framework uses the OpenCASCADE CAD kernel for these operations.

Step 2: Visual attributing

➢ The framework uses a **grammar-based metaphor** in order to encode the semantic connection information of all part models.

➢ The core of this metaphor is the concept of so-called **handles**. These virtual objects can be directly attached to all parts in the immersive environment and configured to describe their **connection semantics**. The result is stored in an XML-based grammar that effectively describes the possible set of part combinations, which may form the product. Additional information, such as **time and costs needed for production**, can also be added to the grammar.

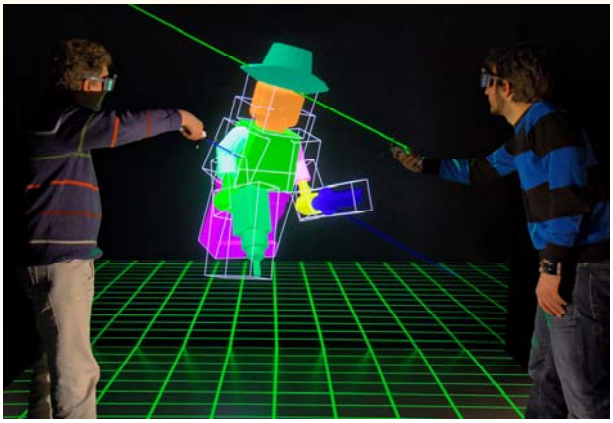


Step 3: Rapid customization

➢The user interface of this module uses **context based adapted two-dimensional menus** as well as **three-dimensional widgets** for system control tasks.

➢ In addition to the most frequently used manipulation techniques, namely the **assembly and disassembly** of parts, this module provides functionality to **visualize** additional attributes for parts and groups of parts, **inspect** current part connections, **change** the illumination and the material properties.

➢ The output of the module is an **assembly graph** containing the set of parts needed for production and its exact connectivity information.



web: www.iais.fhg.de/ve.html contact person: Maxim Foursa e-mail: maxim.foursa@iais.fhg.de