

Introduction

The software aids in the modeling of procedural geometry, i.e. models that are defined by a set of rules. These rules represent a construction plan that describes the successive construction of the entire model.

The system supports the modeling of such construction rules as a network of basic geometric operations. The defined order of operation describes the overall transformation of the input geometry into the desired output model. The user is actively supported in his modeling task by the consequent use of visual feedback for all immediate results. The network itself is composed of two different classes of components: nodes and edges.

Nodes

In general, each node is composed of a preview, displaying the available and newly produced geometry, and a set of context buttons.

In-/Output Nodes

The input node supplies a geometric model, which represents the source for all following operations. The output node collects the geometry from all connected nodes and merges all components to the final model, that is visualized in an interactive 3D viewport (see Figure 1). Both node types are an integral part of the geometry network and are therefore provided by the system. They cannot be replicated or deleted by the user.

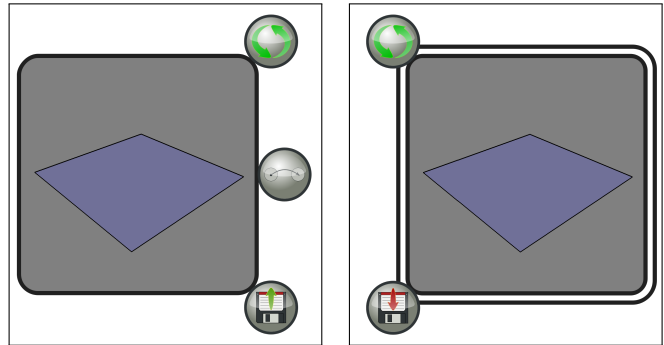


Figure 1: *Input and output node.*

Operator Nodes

Each operator node performs a specific transformation on all incoming faces. Faces that are produced in the process can themselves be processed in following operations. At the moment a total of three elementary operations is supported by the system (see Figure 2):

Extrude: this operator extends a given face to a cube or more general to an ashlar. Beside the height and the option to remove the top face, it offers the application of an inset in x- and y-direction (e.g. windows, wood casings, etc.) by scaling the top face.

Subdivide: a given input face is subdivided by a given number of subdivisions in x- and y-direction.

Pyramid: this node offers a simple way to terminate faces (e.g. roof, tip).

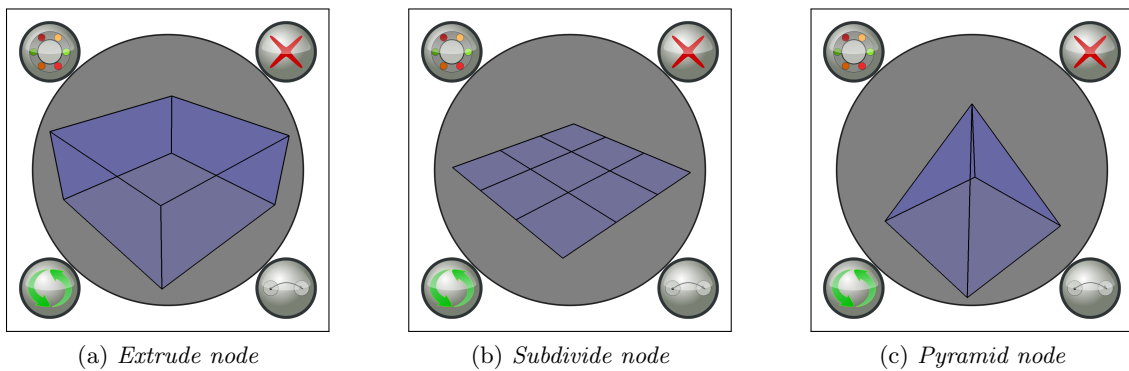


Figure 2: *Each operator node offers four buttons: variation view, delete, update network from this node and create new connection (clockwise from upper left).*

Group Node

A group node can be created by selecting a valid subnetwork and pressing **Ctrl+G**. A subnetwork is valid if and only if it represents a connected subgraph with only one node on the lowest level (see Figure 3). Besides of simplifying a network by minimizing a group node, its main purpose is to define more complex operations as rules and to allow their iterated execution. The defined operation is applied to all faces that are selected and directly send to the group node. To ungroup an existing group you can press **Ctrl+Shift+G**. Instead of the variation view button, a group node features a button to minimize and maximize the defined rule.

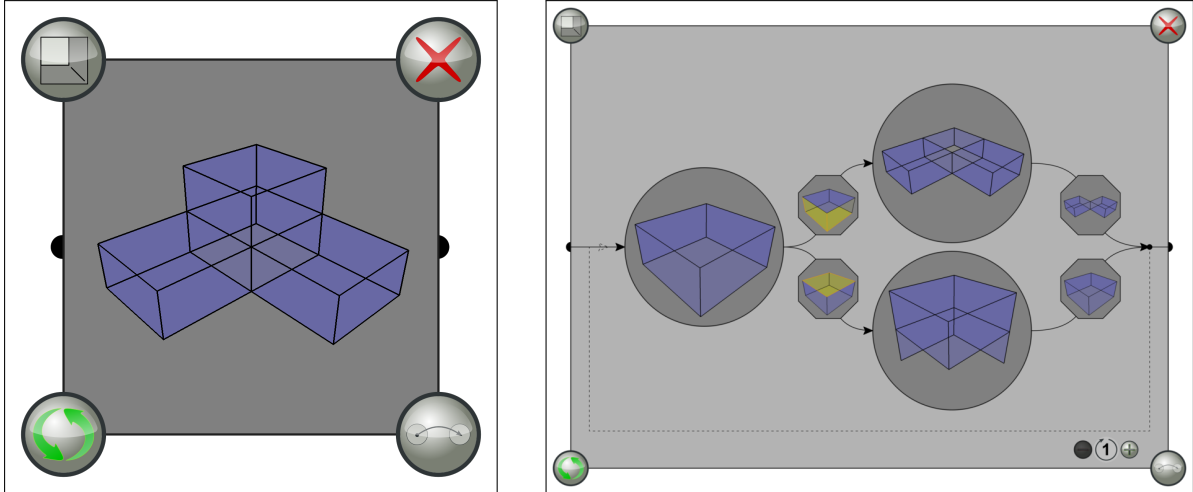


Figure 3: A *minimized (left)* and an *expanded (right)* version of a group node.

Variation View

The variation view allows to set the parameters of a selected node by providing previews as visual feedback (see Figure 4). This visualization illustrates the relationship of the different parameters, which influence the final result.

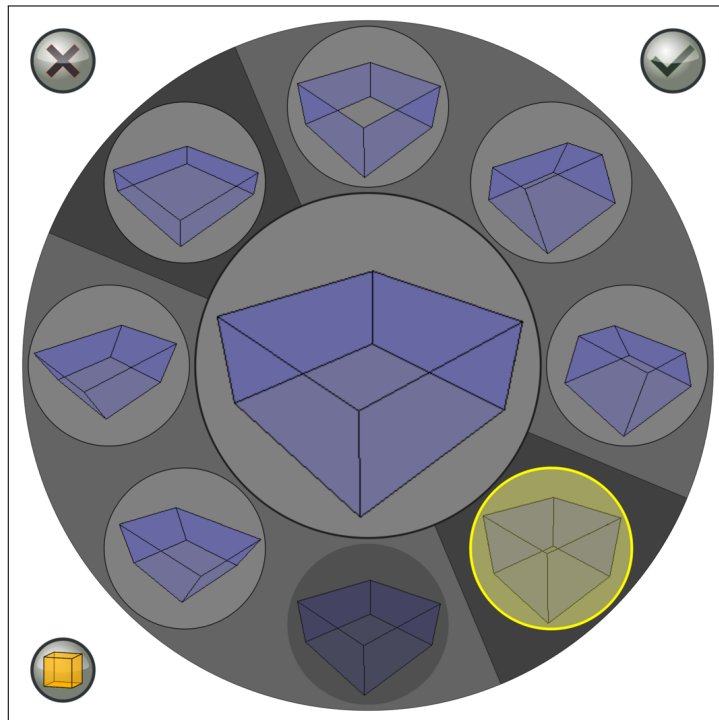


Figure 4: *Variation view of an extrude operator.*

Edges

An edge defines the order of successive operations and holds the selection of faces that shall be processed in the following operation (see Figure 5). It allows for the easy insertion of an internode, replacing the current target with the new node and creating a connection from the new node to the old target.

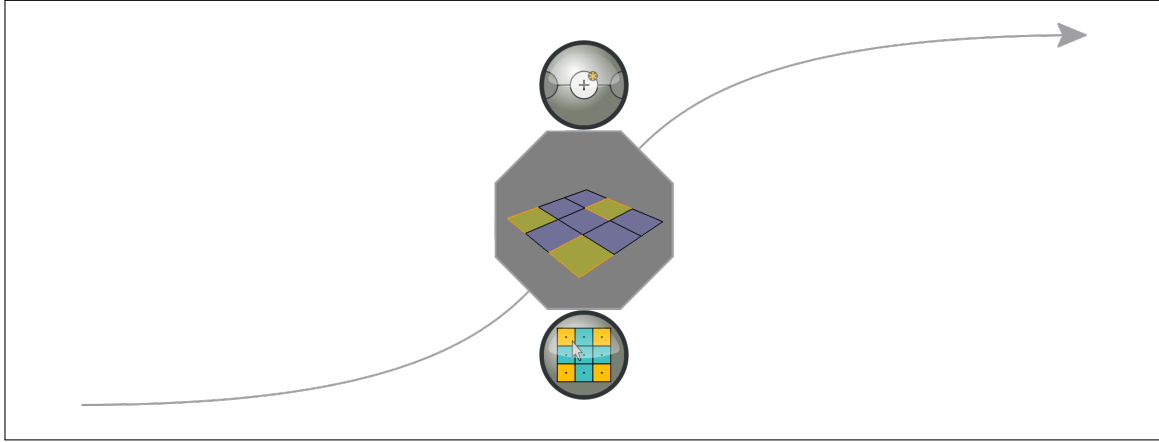


Figure 5: An edge storing a selection of faces produced by a 3×3 -subdivide operator and its buttons: insert new internode (top) and edit selection (bottom).

Selection Dialog

The selection dialog supplies previews of all currently available faces that can be selected for further processing in the following operation (see Figure 6). On the left side all selectable faces are visualized independently and on the right side the combined preview of all currently selected faces is displayed. In the middle a set of common quick selectors is supplied.

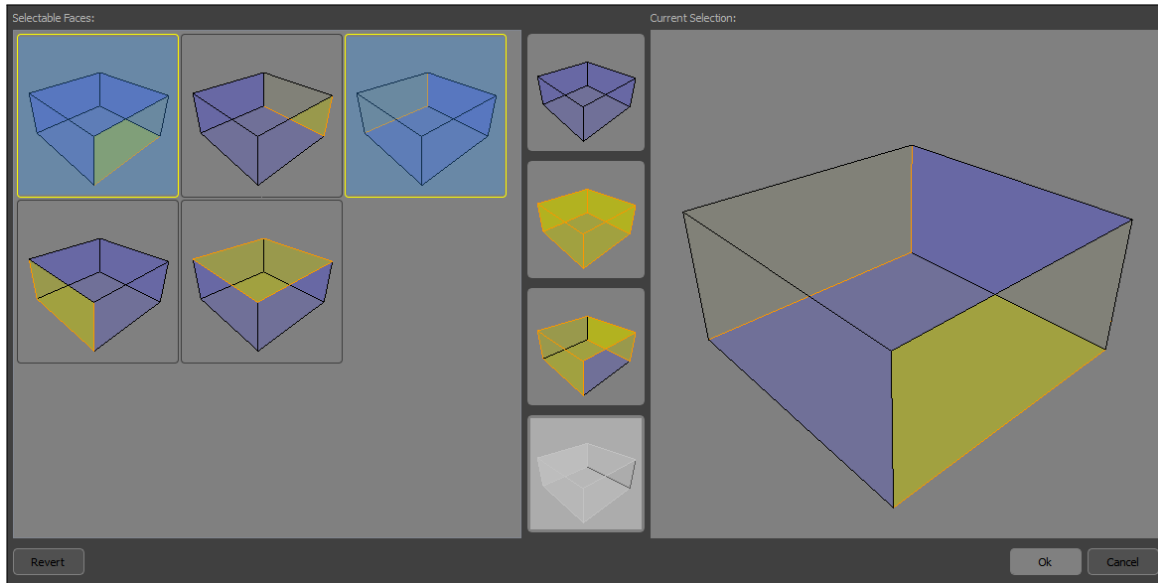


Figure 6: Selection dialog for the produced faces of an extrude operator.

These selectors represent the actions “select all”, “select none”, “invert selection” and “select remaining” from top to bottom. The last selector is only available if a node has more than one outgoing edge and can therefore distribute its output on different operations. If activated it selects all remaining unselected faces, i.e. all faces that are currently unselected on all sibling edges. Furthermore, the selection of faces is mutually exclusive. This means if a face is selected, which is already selected on a different edge, the selection is transferred from the old edge to the new edge. On the bottom left of the dialog a reset button is supplied to easily discard any modifications without the need to close and reopen the dialog.

General Usage Hints

It is possible to select multiple nodes at once by holding the **Ctrl**-key and performing a rubber-band drag operation with the mouse. All nodes can be replicated by copy&paste (**Ctrl+C**, **Ctrl+V**), except for the input and output nodes. An additional paste operation is supported, if only a single node is copied at once. If another node is selected and a paste is performed, the selected node is transformed into the type of the copied node and all its respective parameter settings are transferred. Also, if the paste is applied while a single edge is selected, a new internode of the copied type is inserted and all copied settings are applied. Similar to other programs all user actions can be easily undone (**Ctrl+Z**) and redone (**Ctrl+Y**).