A Blender addon for the 3-d digitizer FASTRAK for plant structure acquisition

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Introduction

An addon for the open-source 3-d graphical modelling software Blender was implemented. It enables communication with the electromagnetic 3-d digitizer FASTRAK via a serial interface. Discrete and continuous point acquisition mode, immediate visualization in Blender's 3-d view, acoustic feedback, creation of standard geometry (e.g., cylindrical internodes) and of free-form volumetric shapes (for fruits, tree trunks etc.), calibration and rectification in case of field disturbances, and MTG export are supported. Tests confirmed that the addon has some advantages against previous software for the FASTRAK digitizer. It is independent of the operating system.

Overview

Blender (Blender Foundation 2012) is a multi-purpose, open-source 3-d modelling tool providing various interactive navigation, editing and animation functions (Fig.1).

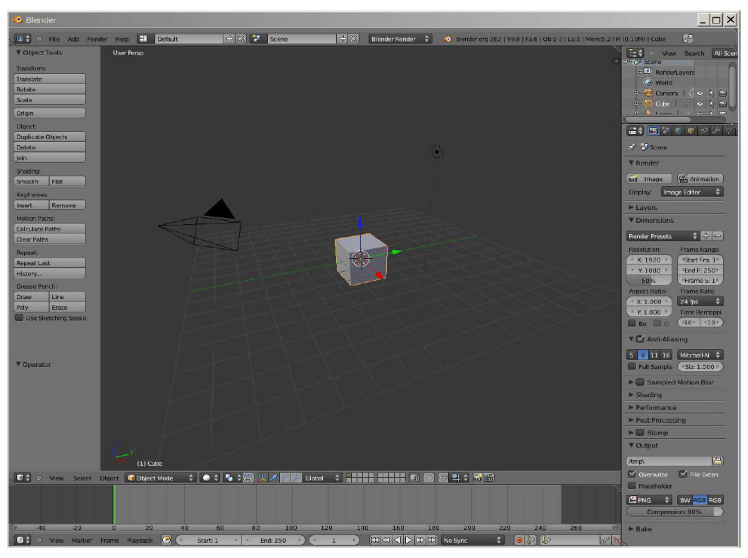

Fig. 1: Screenshot of Blender.

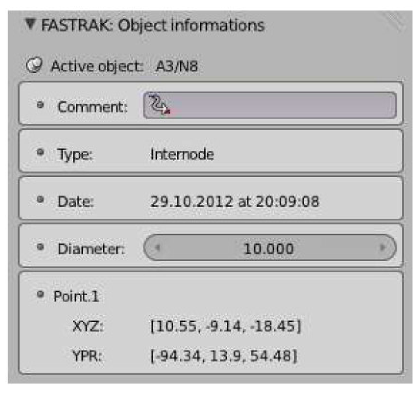

Fig. 2: Access to individual plant elements.

Fig. 3: Editor for MTG output.

We implemented an addon which can be activated within the GUI of Blender (Fig. 2) and which communicates with the Polhemus FASTRAK® digitizer, using a serial interface. Our addon provides some extensions compared to existing software (e.g., PiafDigit: Donès et al. 2006), namely, the option to switch between discrete and continuous position acquisition mode, improved calibration and rectification facilities (using linear transformations), as well as acoustic feedback during the tracking process. Resuming of measurements after an interruption is supported, based on reference points. Export of the resulting 3-d virtual plants in simple tables and in a subset of the MTG data format (Cokelaer & Pradal 2009), which can be processed by GroIMP (Kniemeyer & Kurth 2008) and by OpenAlea, is possible (Fig. 3). Future improvements will include extensions to the MTG export and enhancement of the triangulation method which we currently use for free-form shapes (leaves, fruits, flowers).

The digitizer

The Polhemus FASTRAK is a 3-d tracking system, operating with an electromagnetic field (Fig. 4). It requires a manual tracking of the structures to be measured, using its receiver which has the form of a pencil. Compared to laser-scanning, the amount of human interaction is higher, and less points can be captured per time. On the other hand, the interactive process allows to take morphological information into account which cannot be derived from laser scans (e.g., scars delimiting growth units in tree branches). Occlusions and surface reconstruction are less problematic than in laser scans.

Fig. 4: Polhemus FASTRAK sender (left) and receiver (right).

Correction of field distortions

The FASTRAK digitizer is sensible to distortions of the electromagnetic field, e.g. due to pieces of nearby metal. Our addon can correct stationary distortions (Fig. 5) by a simple calibration procedure, done once prior to the measurements.

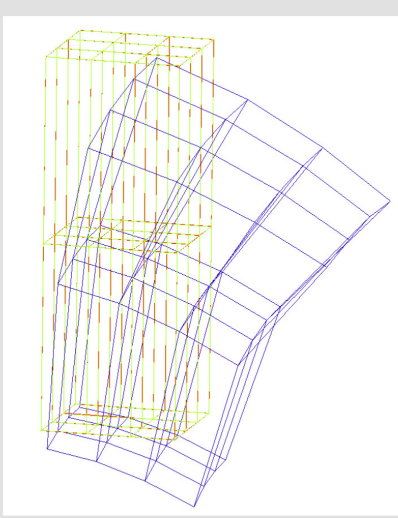

Fig. 5: Compensation of distortion at the example of a box. Original box: red. Measured box: blue. Corrected box: green (visible only where it deviates from the original one).

Modes of operation

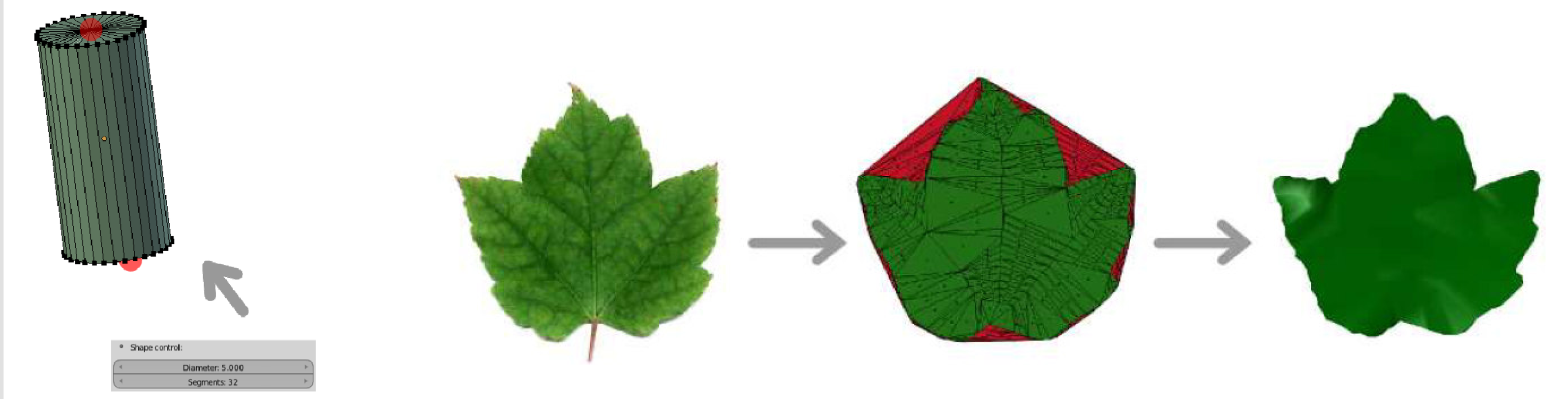

Fig. 6: In the (default) discrete mode, positions are only taken on demand (by pressing the button of the pencil). The system connects the points by geometric primitives (left). Continuous mode is utilized for capturing outlines of leaves or 3-d shapes of fruits. A mesh is generated by a 3-d triangulation algorithm (right).

Results

Fig. 7: Photograph of a strawberry plant (left) and virtual reconstruction as result of using the FASTRAK 3-d digitizer with the new Blender addon (right; from Wasilczuk 2012).

Fig. 8: A young poplar (*Populus* sp.) plant, measured using the Blender addon and rendered with GroIMP, using predefined, textured leaf shapes.

Fig. 9: A young beech (*Fagus sylvatica*) plant, obtained in the same way as Fig. 8.

Acknowledgements

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Contact

- Department Ecoinformatics: `http://www.uni-goettingen.de/en/67072.html`
- Blender: `http://www.blender.org`
- The addon is available (for MS-Windows or Linux) on request: e-mail `wk@informatik.uni-goettingen.de`
- Thesis (in German): `http://www.uni-forst.gwdg.de/~wkurth/wasilczuk_ba.pdf`

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