PACMAN, MEET ARCHITECTURE

Agent-Based Design for Early Form Generation

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Abstract. In the context of site planning, numerous forces have to be considered: Wind, sun/shading, the surrounding (built) environment, visibility and so on act as influential factors for the initial design of a building, when it comes to the establishment of a massing model. In our workshop, we have inscribed these forces into a 3D matrix acting as a natural habitat for agents. These agents then move along their preferred direction - some might seek cells with high shading, others will try to stay away from highly visible (and therefore: public) cells - leaving trails as they move along. The sum of all trails establishes a rough form of a structure, which can be exported for further detailing into a 3D modeling package.

Keywords: *Agent-Based Simulation, Form Finding, Early Planning.*

WORKSHOP OUTLINE

Design can be seen as a flow problem (see Figure 1): The architects' hand produces an initial sketch by traveling through an information space containing, for each cell, the qualities that have been established during site analysis. The architect can either pick up some of these qualities in his design (i.e. *requirement-driven* design) or ignore them and produce only form (*driven by aesthethics*).

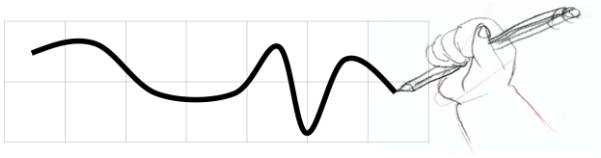

Figure 1
Design as a flow problem: The architects' stylus moves through a grid space according to the forces contained in each grid cell. Hand image courtesy of Ward Jenkins, wardomatic.blogspot.co.at.

For the workshop, we simulate this process using *Agent-Based Simulation*: Given an initial data matrix containing the results of the site analysis in the form of percentages, we *seed* a flock of agents at specific spots in 3D space (e.g. on the surface of a center sphere or diagonally along the edges). By letting the agents travel through the data matrix according to rules (written in the NetLogo simulation language), we arrive at trails that can then be recorded and brought into a 3D software (Figures 3 and 4).

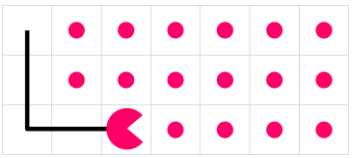

Figure 2
Agent-Based Design generates trails based on behavioural rules

PARTICIPATION AND RESULTS

We had around ten workshop participants with no previous knowledge of programming or multi-agent simulation.

Therefore, we had to initially bring a short tutorial, split into two parts:

- The initial data generation from site analysis, in the form of a short impulse lecture given at the begin of the day.
- The actual NetLogo programming intro, which took until midday.

Over the course of the afternoon, we applied this knowledge to elaborate a full-fledged simulator and transfer its results into a 3D modelling package. Students included their own behavioural rules into the agent simulator, thereby arriving at different forms. However, their success was somewhat limited by the steep learning curve they had just experienced, read: Their programming knowledge was still too little to be at ease with specifying any complex rules in a formal way. A second aspect to consider was that it wasn't "easy" to produce results in the way that our participants imagined; they would rather have to go fiddle with the rules and run the simulation to observe its results, which seemed a bit implicit for them. The workshop results (slides, tutorial programs, extras) were made available under www.iemar.tuwien.ac.at/?page_id=1299, which is a page where we want to also host further work in the matter of Agent-Based Design.

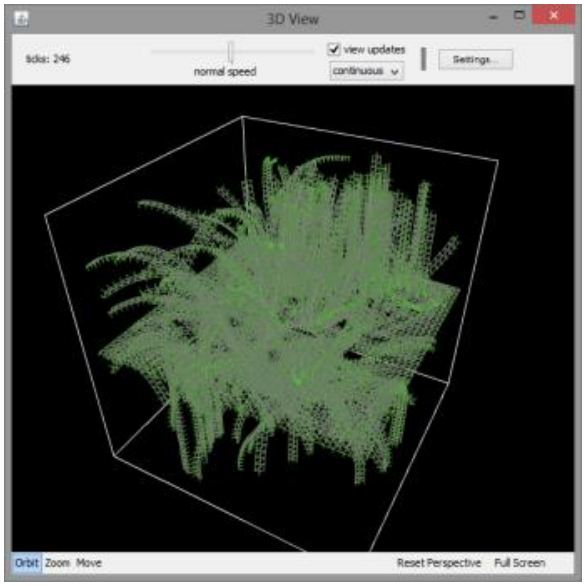

Figure 3
Agent trails from the simulation

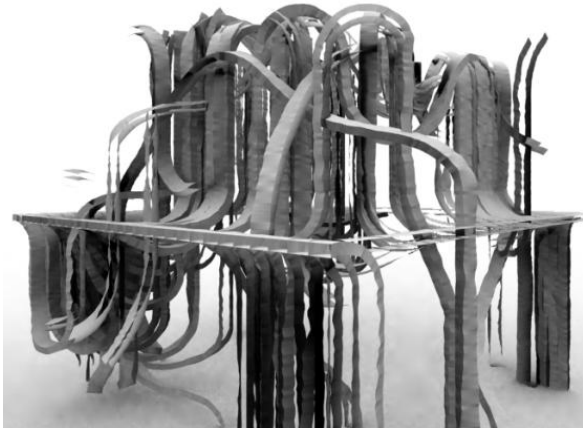

Figure 4
Extruded trails inside a 3D modelling package

Figure 5
Participants during the workshop

ACKNOWLEDGEMENTS

We want to thank the workshop organisers and supporting staff for having us in Bialystok. Likewise, we want to thank all participants (see Figure 5) for their work, it was amazing to see so many people learn such a non-trivial subject matter so quickly.