

Visual Analytics of spatio-temporal simulation data: evaluation of a model of spatial reorganization in North- Western Europe, A.D. 800 to 1100.

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ABSTRACT

This proposal originates from the [ANR TransMonDyn](#) project, which aims at analysing settlements systems evolution over the long time using modelling. This project gathers many case-studies, and I plan on presenting one of those, that aims at a better understanding of the social and spatial processes that happened in North-Western Europe between 800 and 1100 A.D.

Through this period, archaeologists and historians (TANNIER & al., 2014) observed a major change in the settlement structure, to which we refer as the “800-1100 *transition*”: - The peasant households, mostly sprawled around 800, tend to cluster around functional attractors, mainly castles and churches. Furthermore, they cluster for a longer time than during previous periods, and this clustering and fixation are at the origin of villages and small towns. - These aggregates of population and the simultaneous Gregorian Reform lead to a stronger religious control over the peasants, and results in the appearance of a regular grid of parishes designed around the churches. This well-defined and structured territorial meshing is at the origin of current administrative organisation.

We model these processes using an agent-based model, built with the GAMA platform (GRIGNARD & al., 2013), in which we can test our hypotheses on the triggers and mechanisms that produced the observed changes. Our main hypothesis is that these changes are mostly due to the crumbling of aristocratic power, resulting in a stronger hierarchy of lords and in a more locally-centred exercise of power. Two types of agents are used in the model, the lords and the peasant households: – Peasant households move in order to fulfil their needs: paying less taxes, getting a better military protection and moving closer to churches to be able to attend more frequently the religious services. – Lay lords build castles, collect different dues, and grant lesser lords guardianship over their rights. The lords are the ones driving the dynamic, considering their policies attract or push away the peasants. These ones are the markers of the transition, as they design the spatial structure which emerges.

Due to the lack and uncertainty of empirical data, and considering that it mostly relies on expert qualitative knowledge (for example ZADORA-RIO, 2008), we cannot define fitness functions, or simple output indicators that would allow the evaluation of the model. We have to find a first set of parameters so that the model reproduces a situation that experts would validate, choosing a method to allow defining what a “good run” is. The number of parameters, their relations (some depending on the others), and the need to proceed “in real-time” in an interactive way following the reactions of the experts, do not allow the use of automatic calibration methods (SCHMITT & al., 2014, HIRTZEL, 2015). Instead, we chose to use a visual approach, based on multiple display types to allow the specialists to understand and assess the output of an experiment. We base our exploration method on the field of *GeoVisual Analytics* (ANDRIENKO & al., 2003), that we consider as a fitting interface between modellers and thematicians. This parameterization will be driven by the use of a custom platform built up for the analysis of long-time spatio-temporal simulation data.

This communication aims at presenting the model and its parameterization method using our exploration platform. We will also give a feedback on the process of modelling and evaluating in an interdisciplinary context.

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