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MWGRID: DISTRIBUTED AGENT-BASED SIMULATION IN THE DIGITAL HUMANITIES

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ABSTRACT

Digital Humanities offer a new exciting domain for agent-based distributed simulation. In historical studies interpretation rarely rises above the level of unproven assertion and is rarely tested against a range of evidence. Agent-based simulation can provide an opportunity to break these cycles of academic claim and counter-claim. The MWGrid framework utilises distributed agent-based simulation to study medieval military logistics. As a use-case, it has focused on the logistical analysis of the Byzantine army's march to the battle of Manzikert (AD 1071), a key event in medieval history. It integrates an agent design template, a transparent, layered mechanism to translate model-level agents' actions to timestamped events and the PDES-MAS distributed simulation kernel. The paper presents an overview of the MWGrid system and a quantitative evaluation of its perfomance.

1 INTRODUCTION

Agent-based simulation, as a means to model and explore the effect of individual action in complex systems has recently witnessed an explosion of interest and application in a wide range of domains. Perhaps surprisingly, one of these domains is historical studies. Historical interpretation is associated with clear narratives defined by a series of fixed events or actions. In reality, even where critical historical events may be identified, contemporary documentation frequently lacks corroborative detail that supports verifiable interpretation. Consequently, for many periods and areas of research, interpretation rarely rises above the level of unproven assumptions, rarely or never tested against a range of evidence.

Agent-based simulation provides a vehicle to recreate and study historical societies and events. Recent include the analysis of resource exploitation by Mesolithic hunter gatherer groups (Lake 2000) and the Prehispanic settlements in North America (Kohler, Johnson, Varien, Ortman, Reynolds, Kobti, Cowan, Kolm, Smith, , and Yap 2007) have generally involved the analysis of small-scale groups at individual or household level rather than larger societies (Lake 2007). The "Medieval Warfare on the Grid" (MWGrid) project at the University of Birmingham in the UK utilised agent-based modelling to study behaviour dynamics at a large scale, within the context of modelling logistical arrangements relating to the march of the Byzantine army to the battle of Manzikert (AD 1071) - resulting in the collapse of Byzantine Empire in central Anatolia (Haldon 2005).

MWGrid developed a modelling framework for modelling agents, a distributed simulation infrastructure and a series of complex models of the marching Byzantine army for what-if analysis incorporating a rich set of data, both historical and current. Although the MWGrid infrastructure and framework was developed especially to support the MWGrid model, the interface it provides can also be used for other (types of) agent-based models.

2 THE MWGRID FRAMEWORK

The MWGrid framework consists of the model, the simulation system and the analysis environment (Murgatroyd, Craenen, Theodoropoulos, Gaffney, and Haldon).

The model consists of two main elements: the environment representing the terrain, infrastructure and resources of Anatolia; and the agents, representing the human and animal members of the Byzantine army on a one-to-one basis.

As a simulation infrastructure, MWGrid intergates the PDES-MAS system(Logan and Theodoropoulos 2001). The simulation system executes the model and produces detailed trace files that are fed into the analysis system for off-line post-processing. This is achieved via a range of packages depending on the output required. Statistics can be produced detailing movement rates, food consumption, agent health status, amount of time spent on the move and the state of the environment after the army has moved on. These can involve individual agents or the aggregation of statistics of the whole army or certain subgroups. It is also possible to import a transformed trace-file into a 3D modelling package so that a 3D visualisation of the model can be created automatically.

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