

Agent-based Simulation in Market Engineering – Bidding under Uncertainty

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The development of the internet has led to a renaissance of traditional auction mechanisms in electronic form. Electronic auctions are used in manifold ways, e.g. in procurement processes as well as in the C2C area. The design of electronic auctions is important since the microstructural rules affect the auctions' outcome. Market Engineering is a structured approach to develop and study electronic markets. Agent-based simulations offer one possibility to assess electronic markets. The present work summarizes the dissertation of Clemens van Dinther [3] that brings together agent-based simulation and market engineering and applies it to the problem of strategic bidding under valuation uncertainty.

1 Introduction

Searching an appropriate structure for an economic system is not a new question for economists. But the optimal design of such a system is often unknown. [7, p. 1] argues on the question in what respect the structure of an economic system is unknown: *"Typically that of finding a system that would be, in a sense to be specified, superior to the existing one. The idea of searching for a better system is at least as ancient as Plato's Republic, but it is only recently that tools have become available for a systematic, analytical approach to such search procedures."* It can be observed that the market outcome not only depends on the market participants and their valuations, but also on the market structure which stimulates strategic behaviour of the participants. E.g. [11] have studied the effects of fixed and soft end online auctions¹ finding that bidders in auctions with hard end tend to bid late in comparison to auctions with a soft end.

Thus, it has been more and more called for scientific support in designing and developing electronic markets [13, 17]. One approach for the design of electronic markets has been introduced by [19, 10] as *Market Engineering (ME)* which is understood as a systematic approach to development, analysis and design of electronic market services by integrating work from economics, business administration, computer science, and law.

Economists normally build mathematical models in order to study economic problems including markets. The results of such studies are meaningful since the methodological approach is stringent. But mathematical models are not always solvable and normally have strong assumptions such as rational behaviour of the participants. Alternatively, the research field of experimental economics studies behavioural aspects under laboratory conditions. This reveals the real behaviour of participants but also faces other problems such as costs², learning effects during the course of the experiment, or a

¹ In auctions with hard end, the auction is terminated at a predefined time, whereas auctions with soft end continue until no additional bid has been sent during a certain time period.

² Participants receive a monetary reward for their participation.

distortion of the results due to different previous knowledge of the participants. The advancements in simulation in general and agent-based economics in particular open the door to a third approach. The idea of using computer simulation for studying social phenomena dates back to 1969 [14] but was not intensively pursued in those years due to the low computing capacity. During the last decade the use of software agents for simulating problems of social science became more and more popular. The Santa Fee artificial stock market [1] is to be cited as one of the precursors for simulating economic problems. [16] coined the term "Agent-based Computational Economics" (ACE) and provided an introduction to the field.

The dissertation [3] concentrates on bringing together the work of both fields, Market Engineering and Agent-based Simulation for the evaluation of electronic markets. It summarizes the economic foundations of electronic markets and Market Engineering as well as the basics of agent-based computational economics. A short survey on common agent-based techniques and their link to economic approaches such as game theory is also provided. An agent-based simulation tool was developed that was integrated in the generic market platform *meet2trade* [20], and thus, builds the basis for a Computer Aided Market Engineering approach. The main focus of the dissertation is on the application of agent-based simulation to the problem of uncertainty about one's own valuation. This problem is not only used as a proof of concept but also to get more insights in the functioning of electronic markets. In the remainder of this article, we sketch this problem of bidding under uncertainty and related work in Section 2, present the simulation approach and discuss the results of the simulation in Section 3, and conclude this article with a brief summary and an outlook on future work.

2 Bidding under Uncertainty

Auction theory often assumes rational bidders being certain on their valuation, but in reality effects can be observed that are not alleageable with standard theory. The determination