Distributed Agency

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ABSTRACT

Distributed Agency is the name of a conceptual framework for describing complex adaptive systems that this paper develops. To understand the complexity of the world in a holistic fashion, the field of Modeling and Simulation is currently lacking a common terminology in which different bodies of knowledge can communicate with each other in a general language. In this work, agency is proposed as the common link between the different dimensions of reality, expressing the influence of one dimension on another. This conceptualization is based on a process of backwards induction where nested actors such as an evolved organism or a human choice can be represented as the resulting force of intertwined aims and constraints. The theoretical framework can serve as a point of reference for the social and computational researcher by communicating structural and emergent properties that are essential for the understanding of social and evolutionary phenomena such as companies, economies, governments, and ecosystems.

Keywords: Adaptive Complex Systems, Distributed Agency, Modeling and Simulation, Multi-Agent Systems, Social and Evolutionary Phenomena

1. INTRODUCTION

The main task of this paper is to generalize the concepts of agency and revealed preference, and we begin by providing a novel definition of what an agent is, at least in an operational sense, further developing the idea of a holonic agent (Marik, McFarlane, & Valckenaers, 2003). Unlike traditional definitions, we assert that nothing we find in the real-world is a perfect agent (Jensen, 1994). Instead, what takes the place of a traditionally defined agent—such as a person or a company—is an entity that only enjoys a limited amount of agency (Ghassem-Aghaee & Oren, 2003). In this sense, the ‘fuzzy’ agents we consider can only be defined in a quantitative, rather than in the traditional qualitative way (Suarez, Rodriguez-Diaz, & Castañón-Puga, 2008), meaning that one can only refer to actors that are more or less of an agent than others, instead of the traditional separation between agents and objects (De Landa, 2006).

Agency, in this work, is a concept that can only be understood in context and is considered to be dispersed holistically across the system. It is therefore referred to as Distributed Agency (DA). The idea behind a framework for describing agency in this way stems from a view of the world in which emergence is pervasive, in which we find gestalts; wholes that are irreducible to their parts and therefore exist in distinct dimensions where different rules apply.

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(Nonaka & Nishiguchi, 2001). In such a world, the independence of events that is assumed in classical statistics theory no longer holds true and a holistic approach is necessary (Crutchfield, 1994; Biggiero, 2001).

In order to appropriately model complex human behavior we must define a canvas in which multiple dimensions of our existence can be defined (Stepney, Polack, & Turner, 2006; Tolk, 2012). Emergent phenomena are ubiquitous in systems that are separated into distinct ontological levels, such as it is in human societies full of consumers, coalitions, families, loyalties, firms, laws, cartels, institutions and governments (Márquez, Castañón-Puga, Castro, & Suarez, 2011). In this sense, our proposal cannot be tied to any one particular model. Instead, the intent is to create a way in which a myriad of non-orthogonal but distinct bodies of knowledge can be expressed in a meta-model of translatable terminology. If we think of a model as a song, then DA could be more accurately compared to a musical staff in which any song can be written than to any particular composition.

While the ultimate aim of this work is to foster the discussion for the development of a common interdisciplinary language to describe multiple levels of reality, the immediate aim is to propose a framework that can be used in the computational description of a multidimensional reality. The rapidly expanding world of the computer simulation—a paradigm with foundations generally related to Multi-Agent Systems (MAS)—is based on independent agents that strategically interact with each other (Van der Hoek & Wooldridge, 2008). The independence granted to the agents in MAS is a computational one, in the sense that each agent processes information internally, without the need to resort to the outside world to draw conclusions about the inputs it receives (for an example of advances in this field, see Zhang, Coleman, Pellon, & Leezer, 2008). In contrast, the proposed DA language allows for a broader computational description of the world, while at the same time allowing for a higher level of realism that the researcher may consider appropriate.

In our proposed generalized modeling architecture, we redefine collections of individuals as operational units and we decompose wholes into their forming parts. Generalizing the concept of revealed preference (Richter, 1966; Chavas & Cox, 1993; Varian, 2006), we propose a benchmark position in which all actions are revealed as selfish once one understands what the benefited acting agent is. According to this proposition, suboptimal behavior is often misclassified because we do not recognize the actual agent involved. Traditionally, we began with a clearly defined agent and tried to understand its actions as a maximization of objectives given constraints. In the proposed framework of DA, we assume maximization occurs, and then work towards the delineation of the benefited entity involved.

Economic science has been built on the pillars of revealed preference, which basically states that the only information that this discipline can draw from are the preferences of individuals. The concept is an important one, since it reminds the researcher not to ascribe spurious qualities to the individuals studied and abstracted by a utility function; such a function is a mere representation and may contain aspects that do not actually reflect the individual’s nature (Stigler, 1950). Aside from the ongoing discussion this work elicits on how to define an individual, (and whether or not this would be a transitory entity), we find this practice essential in any model of human behavior. In other words, until we have more formal ways of extracting information directly from the neural circuitry of each human, our only data is the actual preferences observed in the real world, actual social structures, actual evolved organisms.

An ontological framework for describing of behavior must not only allow for the description of any physical aspect of the world, but also a way to describe how the different aspects of
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