Ontological modeling of events based on the notion of systems (extended abstract)

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Abstract

In this extended abstract, we present a novel approach for the ontological analysis and modeling of events, rooted in the notion of systems.

Keywords

ontologies, events, processes, occurrents, perdurants, systems, dispositions

1. Introduction

Events are widely regarded as things that *happen* in time and involve continuants as participants [1]. The notion of *event* is usually conceived as a transition through a sequence of snapshots of a part of the world, with each of such snapshots corresponding to the qualitative arrangement of the participants of the event at each time [2, 3, 4, 5]. This succession of snapshots describes the trajectory of the participants of the event through various quality spaces [4][6, p.22]. Complementarily, it is understood that such transitions occur via the manifestation/realization of dispositions – or other realizable entities – that inhere in the involved continuants [7, 8, 3, 4]. With that, we have the means to represent numerous intended models of events in a rich manner.

Even so, there are several open issues regarding means to constrain models of events. Notably, we have the issue of determining what participates in an event. Similarly to how a principle of unity relates the parts that compose a whole and explains how a thing with many parts is a single individual rather than a plurality, we need a principle that integrates the participants involved in an event and explains how the qualitative variations of a collection of objects consist of a single event rather than various unrelated individual trajectories through quality spaces.

Moreover, with such a principle, we can also identify what is *not* participating in the event at a given time. Thus, in some sense, this principle delimits an event by determining the boundaries of the portion of the world subject to the event. In fact, it is only after identifying such boundaries that we can properly investigate the relationships between an event and its surroundings. Thus, a good delimitation criterion would allow us to unravel novel aspects of events that could enrich our models, such as various types of influence between events.

Although there are proposals in the literature for such a principle, all of them present notable shortcomings. Consequently, there is a lack of constructs to account for some modeling scenarios, such as the interaction between events. In view of that, we have been conducting research towards a theory for the ontological analysis and modeling of events that establishes a set of modeling constraints to guide those tasks and offers a set of modeling constructs to deal with facets of events that are still not fully covered in the literature.

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2. Approach Overview

Our approach is rooted in the notion of (concrete) *system*, *i.e.,* a collection of interconnected objects such that they affect the behavior of one another, forming an integrated whole, rather than a mere aggregate of loose things [9, 10][11, p.53] [6, p.4]. Besides the long research history on this notion, it has recently received increasing attention from the Formal Ontology community, even relating this notion to that of events [12, 13, 14].

We use this notion to devise a delimiting principle for events, tying the delimitation of an event to its nature as a manifestation of dispositions. With that, we introduce the idea of *system-invariant event*, *i.e.,* a transition through a sequence of snapshots of a single system of dispositionally connected components. Then, by exploring the implications of applying this principle, we derive a set of types of events and relations between events that are useful for the ontological analysis and modeling of events. According to the type of the delimiting system, we may have events that are *open* or *closed* to certain external influences.

Given that, we propose the notion of *auxiliary event*, *i.e.,* an event that overlaps with, but is not part of, another system-invariant event and that has some effect on the unfolding of such an event. We also define special types of auxiliary events based on the effect they have on another event (*e.g.,* adding or removing participants, modulating the manifestation of dispositions within the other event), along with suitable relationships to indicate such influences.

Finally, based on that, we lay down some general guidelines for the ontological analysis and modeling of events. For instance, if we assume that an event is closed in a given respect (*e.g.,* closed to the entry and exit of participants), our approach allows us to spot a model of such an event violates such an assumption (*e.g.,* its sequence of snapshots present a variation of participants) and to fix it (*e.g.,* excluding from the model the participants that do not appear in every snapshot).

3. Concluding Remarks

In our current research, we are developing a theory for the ontological modeling of events by starting from some initial assumptions about the ontological nature of events and deriving a series of novel related notions. Based on that, we devise a set of modeling constructs that are arguably useful for the ontological analysis and modeling of events. Moreover, by enabling novel inferences and bringing to light the consequences of certain modeling assumptions, this framework can provide the basis for systematic verification of models of events (*e.g.,* helping in identifying overlooked participants, misclassified entities, inconsistent sequences of snapshots, and other modeling problems). With that, we intend to provide well-founded engineering tools for conceptual modelers.

It is also worth noting that our approach seems to dialogue with other works. For instance, the account of how the happening of an event can be affected by its surrounds seems to have a close relation with the ideas of *context* and of *event modifiers* discussed in [15]. In particular, the distinction between the system that delimits an event and the environment of this system may ground a criterion to delineate the border between an event and its external context. Likewise, the distinction between the properties of the components of a system that are part of such a system's structure and the properties that also inhere in such components, but are not in the structure of the system, may be related to the characterization of the internal context of an event delimited by such a system. Additionally, the notion of auxiliary events can bring further ontological basis for certain notions. For example, it may ground several relations between events, such as *negatively_regulates* [16] or *maintain* and *perpetuate* between states and processes [17], as well as the notions of *countermeasure* and *countermeasure mechanisms* proposed in [18].

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