Solving the frame problem requires a general theory of events (emphasizing actions), and Shanahan undertakes to provide it.

What does a theory of action need?

(1) It can be based on situations, fluents and actions (situation calculus) or on times, fluents and events (event calculus). In any case, it must include the ability to infer that from an initial situation $S_0$, there exists a sequence of actions that will make a certain fluent true. More generally, it should be able to infer that there is a strategy of actions that will achieve the goal.

(2) It needs to handle the frame problem (not having to specify everything that doesn’t change when an event occurs), the ramification problem (getting all the effects of an action), the qualification problem (not having to delimit all the preconditions for an event having its normal effect).

(3) It needs to be as elaboration tolerant as possible. New kinds of events or actions should be addable to the theory by adding sentences. New preconditions for an event should be addable and so should new effects.

Shanahan’s book addresses all these desiderata as well as considerations of practical computability.

Perhaps he gives less attention to epistemological adequacy relative to what people know, i.e., that people should be able to add actions, preconditions, etc. without having to know too much about what is already in the theory.

Shanahan nicely describes most of the formalisms that have been proposed using situation calculus and his favored event calculus.

The exposition of the situation calculus is excellent, except that he ties one hand behind his back by not allowing statements that a certain action does not affect a certain fluent.

His exposition of event calculus is clear, but I can’t compare it with other versions.

The key question is described in his epilog “Is the frame problem solved?”. He offers the following criteria.
(1) “It is representationally parsimonious. No formulae are required to describe the non-effects of actions.”

I don’t like that particular criterion. In natural language descriptions of phenomena, non-effects of actions are sometimes explicitly stated. Other non-effects are obtained from general principles. One example is the discovery at the end of the 18th century that when an object is burned the total mass doesn’t change.\(^1\) Also when a person comes to the house the dog barks, but you cannot infer this if the person is the dog’s master.

(2) It is elaboration tolerant. The addition of new information about new effects of already known actions, about new actions, or about new fluents, require the appropriate formulae simply to be conjoined to the existing theory.

I agree with this criterion and would like to strengthen it. The new formulas needed for an elaboration should only concern the particular domain. It is a blemish if new formulas about the effects of actions in general have to be added.

On the other hand, any concepts used by people should be tolerated. Thus event calculus should tolerate situations and vice versa.

Some comments,

(1) Not letting the theory contain cancellation of inheritance lacks epistemological adequacy. People sometimes think in terms of such cancellations.

(2) Because people sometimes think in terms of situations epistemological adequacy, as discussed in [2], requires that the formalism admit them. The point is more general. The theory of action should not be so delicate as to be spoiled by the additional concepts.

(3) I still prefer situation calculus, and I would like to solve the frame problem with axioms like

\[
\neg \text{ab aspect} \ 1(a, p, s) \rightarrow (\text{Holds}(p, \text{Result}(a, s)) \equiv \text{Holds}(p, s))
\]

that has an explicit situation argument. The Yale shooting problem is to be avoided by doing the circumscription differently.

(4) Projection problems admit simpler circumscription policies than problems which contain assertions about future situations. Perhaps we need theories that are explicit about their policies for nonmonotonic reasoning as is Vladimir Lifschitz’s pointwise circumscription [1].

The above are just opinions about future theories. Solving the Frame Problem is excellent.

References


---

\(^1\) Discovered by burning a candle in a bell jar.