# ELECTRONIC NEWSLETTER ON REASONING ABOUT ACTIONS AND CHANGE

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## Today

David Poole's ETAI submitted article, "Decision Theory, the Situation Calculus and Conditional Plans", is co-reviewed between our area and the area of Decision and Reasoning under Uncertainty (DRU). The following comments by Hector Geffner about the article have been submitted for DRU, which can be seen since they focus on the uncertainty aspect of the article. However they ought to be of interest for readers that specialize in actions and change as well.

## ETAI Publications

### Discussion about received articles

#### Decision Theory, the Situation Calculus and Conditional Plans

**by David Poole**

#### Comment from: Hector Geffner

David,

I've enjoyed reading your paper "Decision Theory, the Situation Calculus and Conditional Plans". I find it hard to disagree on your general point that a general model of action must combine elements from logic and probability/utility theory, so my questions and comments are addressed more to the question of how this combination is achieved in your proposal. I'll try to comment first on the more general issues.

1. In page 24, you say "The representation in this paper can be seen as a representation for POMDPs".

If so, I wonder, why not present the representation in that way from the very beginning? Wouldn't that make things much clearer?

Namely, a POMDP is described by (see [1]):

A - state space
B - actions
C - transition probabilities
D - cost function
E - observations
F - observation probabilities

Then the constructions in your language could be seen as a convenient/concise/modular way for specifying these components.

Actually, once the mapping from the language to these components is determined, no further semantics would be needed (i.e., the probabilitities of trajectories, the expected utility of policies, etc., are all defined as usual in POMDPs). This is actually the way we do things in [2].

2. I can see some reasons why not to present your representation as a "front end" to POMDPs.

- you want to be more general; e.g., be able to deal with cost functions that depend on the system history. If this is the case, I'd suggest to introduce "generalized" POMDPS where (cumulative) cost functions do not have to be additive (btw, in such POMDPS belief states are not necessarily sufficient statistics ..)
- you want to accommodate multiple agents. Yet this is not done in this paper, but even in that case, multi-agent POMDPs could be defined as well, and have been defined in the completely observable setting (e.g., see Littman).
- you are not interested in determining an optimal or near-optimal solution of the POMDP but are interested in analyzing the expected cost of a policy supplied by a user in the form of a contingent plan. Again, this is no problem from the point of view of POMDPs, as long as the contingent plan determines a (stationary or non-stationary) *function*
- *of belief states into actions (see [4]). Indeed, you require* more
- than this when you demand (page 18), that the tests in conditions of the plan, be *directly observable* at the time when the conditions need to be evaluted. This is not required in POMDPs [4] or in possible world accounts [3], where the test may be known indirectly through other observations.

  3. A final comment about a non-trivial problem that results from the decision of removing all probabilities from state transitions transferring them into suitable priors in "choice space".

  Consider the effect of an action "turn_off" on a single boolean fluent "on" with transition probabilities:

$$P(on = false \mid on = true\ ;\ a = turn\_off) = .5$$
$$P(on = false \mid on = false\ ;\ a = turn\_off) = 1$$

Let's say that initially $on = true$ and then we perform a sequence of $N$ consecutive *turn_off*s. Then the Probability of $on = false$ is $0.5^N$, which clearly depends on $N$.

I don't see how this behavior could be captured by priors over choice space. This seems to be a strong limitation. It looks as if probabilistic actions cannot be handled after all. Is this right?

References

[1] L. Kaebling, M. Littman, and T. Cassandra. Planning and Acting in Partially Observable Stochastic Domains, AIJ 1998

[2] H. Geffner, B. Bonet. High level planning with POMDPs. Proc. 1998 AAAI Fall Symp on Cognitive Robotics (www.ldc.usb.ve/˜hector)

[3] H. Levesque. What's planning in the presence of sensing? AAAI96

[4] H. Geffner and J. Wainer. A model of action, knowledge and control, Proc. ECAI 98 (www.ldc.usb.ve/˜hector)

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