

Modal Event Calculus

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We defined an extension of Kowalski and Sergot's Event Calculus (EC) [2] to deal with incomplete information about event ordering. Given a set of events, EC allows to derive maximal time intervals (MVIIs) over which the properties they initiate or terminate hold. When only partial knowledge on event ordering is given, EC is neither able to derive all admissible MVIIs nor to distinguish which of the derived ones are defeasible and which are not. We developed two variants of EC, namely the skeptical (*SKEC*) and the credulous (*CREC*) Event Calculus, such that SKEC derives all MVIIs that are true in whatever final completion of the ordering, while CREC derives those that are true at least in one possible completion of the ordering. Then, we provided a uniform modal logic framework for integrating EC, SKEC, and CREC (*Modal Event Calculus - MEC* for short), where SKEC and CREC are respectively viewed as the operational counterparts of the modal operators of necessity and possibility. Formally, let \mathcal{S} be an *EC-structure* consisting of a set of events E , a set of properties P , and a set of *initiates* and *terminates* relationships R that specify the effects of events on properties, and let o be a partial ordering over E . The relation between derivability (\vdash_{MEC}) and satisfiability (\models_{MEC}) in MEC is expressed by the following theorem [1]:

Theorem 1 *For each structure \mathcal{S} , $p \in P$, $e_1, e_2 \in E$, and each partial ordering o ,*

$$\begin{array}{lll} \mathcal{S}, o \vdash_{MEC} \text{holds}(p(e_1, e_2)) & \text{iff} & \mathcal{S}, o \models_{MEC} p(e_1, e_2) \\ \mathcal{S}, o \vdash_{MEC} \text{skeHolds}(p(e_1, e_2)) & \text{iff} & \mathcal{S}, o \models_{MEC} \Box p(e_1, e_2) \\ \mathcal{S}, o \vdash_{MEC} \text{creHolds}(p(e_1, e_2)) & \text{iff} & \mathcal{S}, o \models_{MEC} \Diamond p(e_1, e_2) \end{array}$$

References

- [1] Cervesato, I., L. Chittaro, and A. Montanari. A Modal Logic Interpretation of the Event Calculus. *Research Report, Dipartimento di Matematica e Informatica, Università di Udine*, 1994.
- [2] Kowalski, R., and M. Sergot. A Logic-based Calculus of Events. *New Generation Computing*, 4:67–95, 1986.