

Towards Streams of Events with Temporally-Constrained Effects

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Stream Reasoning

Problem:

- Continuous pattern matching over data streams
- Low latency
- Reasoning over complex temporal specifications:
 - **deadlines**

Approach:

- Complex temporal specifications \implies Event Calculus
- Efficient stream reasoning \implies Run-Time Event Calculus

Applications

- **Multi-Agent Systems (MAS)** for:
 - Voting
 - Negotiation
 - Argumentation
- **Complex Event Recognition (CER)** for:
 - Maritime Situational Awareness
 - Commercial Fleet Management
 - Activity Recognition
 - City Transport Management

Event Calculus¹

- A **logic programming language** for representing and reasoning about events and their effects.
- Key components:
 - **event** (typically instantaneous).
 - **fluent**: a property that may have different values at different points in time.

¹Robert A. Kowalski, Marek J. Sergot: A Logic-based Calculus of Events. *New Gener. Comput.* 4(1): 67-95 (1986)

Event Calculus¹

- A **logic programming language** for representing and reasoning about events and their effects.
- Key components:
 - **event** (typically instantaneous).
 - **fluent**: a property that may have different values at different points in time.
- Built-in representation of **inertia**:
 - $F = V$ holds at a particular time-point if $F = V$ has been *initiated* by an event at some earlier time-point, and not *terminated* by another event in the meantime.

¹Robert A. Kowalski, Marek J. Sergot: A Logic-based Calculus of Events. *New Gener. Comput.* 4(1): 67-95 (1986)

Run-Time Event Calculus (RTEC)²

A **stream reasoning** system based on the Event Calculus:

- windows
- caching and indexing
- interval manipulation constructs
- efficient handling of **deadlines**

²Artikis A., Sergot M. and Paliouras G., An Event Calculus for Event Recognition. In IEEE Transactions on Knowledge and Data Engineering (TKDE), 27(4), 895–908, 2015.

Deadlines

- Fluent-value pairs may be subject to **deadlines**
- E-commerce: an offer may be accepted **at most by a specified time after** being presented
- Maritime Situational Awareness: a fishing activity is **terminated at a specified time after** multiple changes in heading
- Multi-Agent Systems: agents may be **suspended temporarily**. Further violations may **extend the period of suspension**

Open-Source Code

The screenshot displays the GitHub interface for the repository `aartikis/RTEC`. At the top, there is a navigation bar with links for 'Why GitHub?', 'Team', 'Enterprise', 'Explore', 'Marketplace', and 'Pricing'. A search bar and 'Sign in' / 'Sign up' buttons are also present. Below the navigation bar, the repository name 'aartikis/RTEC' is shown, along with 'Public' status, 'Notifications', 'Star' (50), and 'Fork' (6) buttons. The main content area is divided into three sections:

- Repository Structure:** A table listing files and folders with their commit dates and commit counts.
- Commit History:** A list of recent commits, including the most recent one by 'Periklismant' updating the README.md.
- About:** A section describing the project as 'RTEC is an Event Calculus implementation optimised for stream reasoning', with various topic tags and a license of 'LGPL-3.0'.

File/Folder	Description	Commit Date	Commit Count
docs	added yap installation instructions	7 days ago	
examples	Update README.md	3 days ago	
execution scripts	updated cli script and file structure	3 days ago	
src	minor	15 days ago	
.gitignore	updated structure and readme files	3 days ago	
LICENSE	updated RTEC manual	9 months ago	
README.md	Update README.md	3 days ago	74
RTEC_manual.pdf	minor in manual	7 months ago	
setup.py	added command line interface	7 days ago	

Commit History:

Author	Message	Date	Commits
Periklismant	Update README.md	3 days ago	74

About:

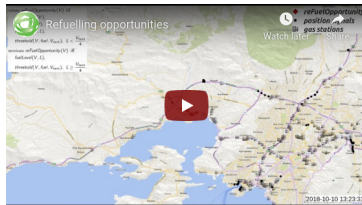
RTEC is an Event Calculus implementation optimised for stream reasoning

Tags: data-science, cep, prolog, artificial-intelligence, stream-processing, logic-programming, complex-event-processing, multi-agent-systems, data-stream-processing, event-calculus, stream-reasoning, complex-event-recognition

License: LGPL-3.0

<https://github.com/aartikis/RTEC>

Complex Event Recognition



<http://cer.iit.demokritos.gr/>

Summary

- RTEC: an **open-source** stream reasoning system based on the Event Calculus.
- **Optimisation techniques** → e.g. 'forgetting' and caching
- Efficient treatment of **deadlines**