

 $\bigwedge\{\ldots\}$ 

 $q \in Q \setminus Q_*$ 

 $(p,q)^\wedge_{\mathtt{a}}$ 

 $0, 0, 0, \min_{\{3,4\}}, 0, 0$ 

Notions of behavioral equivalence are at the heart of program semantics-and particularly tricky in concurrent settings. There are lots of them... We provide a way to determine those most fitting for a set of example systems. This makes it much easier to pick the right equivalence notions for specific modelling and verification tasks.

## SPECTROSCOPY SPECTROSCOPY ENERGY GAME GAMES TO DECIDE BEHAUORAL EQUIALENCES AT ONCE

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DECIDING ALL BEHAVIORAL EQUIVALENCES AT ONCE

**Process Equivalence Problems as Energy** Games

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Abstract. We characterize all common notions of behavioral equiva-

lence by one 6-dimensional energy game, where energies bound capabil-

ities of an attacker trying to tell processes apart. The defender-winning

initial credits exhaustively determine which preorders and equivalences from the (strong) linear-time-branching-time spectrum relate processes. The time complexity is exponential, which is optimal due to trace

equivalence being covered. This complexity improves drastically on

previous approach for deciding groups of equivalences where expone

sets of distinguishing HML formulas are constructed on top of a sur

exponential reachability game. In experiments using the VLTS ben

marks, the algorithm performs on par with the best similarity algori

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We generalize the Bisimulation game:
Attacker moves correspond to a wide
set of formulas that are true for the left
process. Defender moves may outma-
neuver the attacker if the observation
also is possible for one process of a
set of processes on the right. The sub-
set construction allows to also cover
race equivalences. The attacker must
bay with energies if they want to use
pigger parts of HML (an thus finer
equivalences) for the distinction.

 $\min_{\{1,4\}}, 0, 0, 0, 0, 0$ 

 $\min_{\{\mathbf{1},\mathbf{5}\}}, 0, 0, 0, 0, -1$ 

 $(q, \{p\})_{s}$ 

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Linear-Tir	me-Branching- × +		~
$\rightarrow$ C	equiv.io/main/#diverse-e	45 < A 🕈 🗖	* *
I <del>v</del> Expo	ort <del>+</del> Background <del>+</del>		
S = (tau	u.S + tau.Div + ecA.Div	Preordered by:	



We explain the "equivalence spectroscopy problem" and our general approach.

We adapt energy games to solve the spectroscopy problem more efficiently.

NEXT: David N. Jansen and Benjamin Bisping will present a way to extend the approach to the weak spectrum of equivalences that account for silent steps (e.g. branching bisimilarity, contrasimilarity).



Our browser tool allows to exhaustively consider equivalences for small example systems.



