

- ▶ CARLOS A. VARELA, *Formal verification and execution of actor systems*.  
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The actor model of concurrent computation in distributed systems [1] is both: a foundational *theoretical* model for concurrency, and a *pragmatical* paradigm for building distributed systems [2].

We formalize Agha, Mason, Smith, and Talcott’s actor language (AMST) [3] using the Athena proof assistant [4]. AMST extends the call-by-value lambda calculus [5]—as a model for sequential computation—with actor primitives for sending messages, creating new actors, and changing an actor’s behavior.

Athena is a many-sorted first-order logic proof assistant that contains *methods* and *procedures* to abstract over deductions and computations respectively. When methods succeed, they produce theorems, which are guaranteed to be sound by the language, *i.e.*, they logically follow from the axioms assumed during the method’s execution. Since Athena is a dual deduction and computation language, we can both rigorously prove formal properties of actor systems, as well as synthesize executable actor code from the theory [6].

We illustrate the proof of the unique expression decomposition lemma (Lemma 1 in [3]) by structural induction. We also specify computation sequences, computation trees, and fairness. Finally, we outline a number of future research directions, including compositional aspects (*i.e.*, modeling receptionists and external actors for configurations), equivalence of expressions (may, must, and test equivalences, and the partial collapse to two equivalences under fairness), equivalence of configurations, laws of expression equivalence, and proof methods for verification of actor systems.

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