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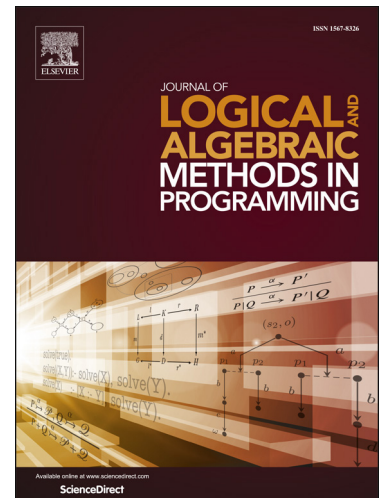
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# A complete logic for behavioural equivalence in coalgebras of finitary set functors

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## Abstract

This paper presents a sound and complete sequent-style deduction system for determining behavioural equivalence in coalgebras of finitary set functors preserving weak pullbacks. We also prove soundness without the weak pullback requirement. Finitary set functors are investigated because they are quotients of polynomial functors: the polynomial functor provides a ready-made signature and the quotient provides necessary additional axioms. We also show that certain operations on functors can be expressed with uniform changes to the presentations of the input functors, making this system compositional for a range of widely-studied classes of functors, including the Kripke polynomial functors. Our system has roots in the  $FLR_0$  proof system of Moschovakis et al., particularly as used by Moss, Wennstrom, and Whitney for non-wellfounded sets. Similarities can also be drawn to expression calculi in the style of Bonsangue, Rutten, and Silva.

*Keywords:* behavioural equivalence, finitary functor, bisimulation up to, signature, compositional presentation

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## 1. Introduction

In this paper, we propose a logic for detecting behaviourally equivalent states in coalgebras of finitary Set-endofunctors. Finitary functors are special because they have presentations whereby they can be represented as the quotient of a signature functor by a collection of equations.<sup>1</sup> The signature provides a syntax in which coalgebras can be expressed, and the equations add the axioms necessary to distinguish reasoning among functors with similar signatures.

In particular, we will consider *specifications* on sets of variables in signatures of finitary functors. These are total assignments of variables to terms which serve as definitions, and may be considered a recasting of the long history of

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<sup>1</sup>Finitary functors in finitely presentable categories outside of Set may also have finitary presentations, see [1].

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