# SPATIAL TYPES FOR CONCURRENCY
# A Spatial Logic to Specify and Verify Distributed Systems

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**ABSTRACT:**
The problem of specifying and verifying properties is considered to be a classical problem in Computer Science. Recently, there has been a growing interest in spatial properties of Distributed Systems. So, several models have been proposed such that the proof systems are, in general, undecidable. An exception is the model-checker of Luís Caires.

Traditionally, type systems are used to guarantee the absence of errors in programming languages, mostly due to being decidable and to their low complexity. But recently, they have also been used to ensure spatial properties of processes.

The aim of this work is to define a decidable logic (syntax, semantics and deductive system), which allows both spatial and behavioural invariants of concurrent processes to be specified and verified.

This work first considers a simple language of processes and an expressive language of formulas. The former is the nondeterministic choice free fragment of a process algebra – Milner's CCS – while the latter is based on the Spatial Logic of Caires and Cardelli and on the Process Logic of Milner. Adopting a "propositions as types" approach, where types are formulas, denotational semantics are established based on notions of structural and labelled transition relations, and subtyping is interpreted as logical entailment. Furthermore, a type system is defined as a deductive system and some results are proved about it, namely weak consistency and completeness. Finally, a complete application of the system is developed, thus expressing its potential.

**KEYWORDS:** Behavioural; Concurrency; Process Algebra; Spatial Logic; Type; Type System.