Open Bisimulation for the Concurrent Constraint Pi-calculus*

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Theorem 1 stating that open bisimilarity $\sim_o$ is congruence does not hold. As a counterexample, consider the following processes.

$$P \equiv (b)\,(x)\,(x = b \,|\, \overline{a}\langle x\rangle.b.c.\mathbf{0}) \quad Q \equiv (b)\,(x)\,(x = b \,|\, \overline{a}\langle x\rangle.\mathbf{0})$$

$P \sim_o Q$ but $P\,|\,R \not\sim_o Q\,|\,R$, for $R \equiv a\langle y\rangle.y.\mathbf{0}$. Indeed, $P\,|\,R \xrightarrow{\tau}\xrightarrow{\tau} (b)(x = b\,|\,x = y\,|\,c.\mathbf{0}) \xrightarrow{c}$ while $Q\,|\,R$ has no such c transition. Adding a structural axiom

$$(x)(U\,|\,c) \equiv (x)(U[y/x]\,|\,c) \quad \textit{if } c \preceq x = y \tag{1}$$

would not solve the problem. Indeed, this addition would invalidate the correspondence between open bisimilarity and symbolic bisimilarity (Theorem 2). As a matter of fact, if we do not introduce axiom 1, by definition of open bisimulation, only a subcase of Theorem 1 holds, namely that open bisimulation is preserved when closing with respect to constraints in parallel.

Another point worth noting is that, in absence of axiom 1, the behaviour of the calculus is different than reasonably expected, as shown by the following fact.

$$(x)(\overline{x}\langle z\rangle\,|\,x = y) \not\sim_o (x)(\overline{y}\langle z\rangle\,|\,x = y)$$

Furthermore, the result that the polyadic explicit fusion calculus can be encoded into the monadic cc-pi calculus and that the encoding preserves their respective notions of bisimilarity (Theorem 3) is not correct. Indeed, the version of explicit fusion presented in our paper is not standard as a basic axiom of the calculus is missing, namely

$$P\,|\,x = y \equiv P[y/x]\,|\,x = y. \tag{2}$$

We are working on a corrected version and we will eventually make it available. We thank Björn Victor who found the above counterexample to Theorem 1.

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