

# Retractable Contracts and Beyond

Recent development

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*Rollback* is a main technique for system reliability [1]: in case of failure rollback allows one to go back to a past safe state, and try to find from there a successful computation path. However, if different partners of a conversation use rollback in an uncontrolled and non coordinated way, inconsistent states may be reached.

We discuss here *retractable contracts*, an abstract model of computation for binary interaction with rollback in form of an extension of classical *behavioral contracts* [2, 5]. In this model rollback is used in a disciplined way: two participants may rollback only if their interaction is stuck, and in this case they rollback to corresponding states. Furthermore, the path that originated the rollback is removed from the possible future computations, ensuring that different possibilities are explored. This avoids the risk of divergence by undoing and redoing the same actions forever. Syntactically, the main extension w.r.t. behavioral contracts is to allow a retractable choice between outputs, with the meaning that an output is selected internally, but the choice can be undone and changed if the interaction gets stuck. Replacing an internal choice with a retractable choice allows a contract to interact successfully with a larger sets of contracts that it used to. We show that retractable contracts give rise to notions of compliance and subcontract relation which are simple and clean extensions of the corresponding notions for behavioral contracts. In particular, a retractable choice and an external choice are compliant iff there exists a path leading to success. Also, an internal choice is a subcontract of a retractable choice including at least one of its options, and a retractable choice is a subcontract of another retractable choice allowing more options.

We also consider a second model of computation, based on the idea that one tries in parallel different computations, and is satisfied as soon as one of them succeeds. Such a pattern, close to the so called speculative parallelism [13], has been explored for instance in web services [6], where it corresponds to the canceling discriminator control-flow pattern [14]. Somehow surprisingly, we show that such a pattern gives rise to the same notions of compliance and subcontract relation of the rollback.

Finally, we highlight the relationships between this work and reversible computing [7, 12, 10, 11] on one side, and session types [8, 9] on the other side. Clearly we are particularly related to works considering the interplay between the two topics [15, 3]. More details on the material presented here on retractable contracts can be found in [4].

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## References

- 1 A. Avizienis, J.-C. Laprie, B. Randell, and C. E. Landwehr. Basic concepts and taxonomy of dependable and secure computing. *IEEE Trans. Dep. Sec. Comput.*, 1(1):11–33, 2004.
- 2 F. Barbanera and U. de'Liguoro. Sub-behaviour relations for session-based client/server systems. *MSCS*, 25(6):1339–1381, 2015.
- 3 F. Barbanera, M. Dezani-Ciancaglini, and U. de'Liguoro. Compliance for reversible client/server interactions. In *BEAT*, volume 162 of *EPTCS*, pages 35–42, 2014.



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- 4 F. Barbanera, M. Dezani-Ciancaglini, I. Lanese, and U. de'Liguoro. Retractable contracts. In *PLACES 2015*, volume 203 of *EPTCS*, pages 61–72. Open Publishing Association, 2016.
- 5 G. T. Bernardi and M. Hennessy. Modelling session types using contracts. *Mathematical Structures in Computer Science*, 26(3):510–560, 2016.
- 6 M. Dalla Preda et al. Graceful interruption of request-response service interactions. In *ICSOC*, volume 7084 of *LNCS*, pages 590–600. Springer, 2011.
- 7 V. Danos and J. Krivine. Reversible communicating systems. In *CONCUR*, volume 3170 of *LNCS*, pages 292–307. Springer, 2004.
- 8 K. Honda, V. T. Vasconcelos, and M. Kubo. Language primitives and type disciplines for structured communication-based programming. In *ESOP*, volume 1381 of *LNCS*, pages 22–138. Springer, 1998.
- 9 H. Hüttel et al. Foundations of session types and behavioural contracts. *ACM Comput. Surv.*, 49(1):3:1–3:36, 2016.
- 10 I. Lanese, M. Lienhardt, C. A. Mezzina, A. Schmitt, and J.-B. Stefani. Concurrent flexible reversibility. In *ESOP*, volume 7792 of *LNCS*, pages 370–390. Springer, 2013.
- 11 I. Lanese, C. A. Mezzina, and F. Tiezzi. Causal-consistent reversibility. *Bulletin of the EATCS*, 114, 2014.
- 12 I. C. C. Phillips and I. Ulidowski. Reversing Algebraic Process Calculi. *J. of Logic and Alg. Progr.*, 73(1-2):70–96, 2007.
- 13 P. Prabhu, G. Ramalingam, and K. Vaswani. Safe programmable speculative parallelism. In *PLDI*, pages 50–61. ACM, 2010.
- 14 N. Russell, A. H. M. Ter Hofstede, and N. Mulyar. Workflow controlflow patterns: A revised view. Technical report, 2006.
- 15 F. Tiezzi and N. Yoshida. Reversible session-based pi-calculus. *J. Log. Algebr. Meth. Program.*, 84(5):684–707, 2015.