

# Proposition de stage de Master

## Lieu :

Laboratoire Spécification et Vérification  
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## Titre : Lossy Counter Machines

## Description du stage :

**Lossy counter machines**, aka LCMs, are a variant of [Minsky counter machines](#) where integer counters are *unreliable* and can lose any part of their contents without any warning. They have been introduced by R. Mayr in [\[May03\]](#) as a simplification of *lossy channel systems*. Because they are unreliable, lossy counters are easier to simulate in various models (timed automata, register automata, temporal logics, etc.) and LCMs have been used to prove hardness of many apparently unrelated questions.

However, the known results about LCMs are still very scarce. Existing results focus on questions motivated by the verification of protocols or distributed programs rather than on more fundamental questions, and most provided answers are not more precise than « decidable » or « undecidable ».

By contrast, when LCMs are used to prove hardness results in other areas, one would like to be able to choose from a wider range of hard questions, provided with more precise answers.

For example, it is known from the literature that the question whether the accessibility set  $Acc(M)$  of a LCM is finite is undecidable [\[May03\]](#). But in order to use this in reduction we would like to know more precisely that the question is in fact  $\Sigma_1^0$ -complete. What about the question whether  $P \subseteq Acc(M)$  for  $P$  a Presburger-defined set of configurations? What about  $Acc(M_1) \subseteq Acc(M_2)$ ? These are all open questions.

The aim of this research internship is to initiate a systematic study of LCMs. It is expected that this research program will be continued under the form of a PhD project but, during the Master Thesis part, we propose to concentrate on the accessibility sets. For these sets, one can obtain various results by using “incrementally bounded simulation” of Minsky machines, a coding gadget from [\[DJS99, May03\]](#) that deserves further explorations.

This research program is directly connected to [MPRI C2-9 course](#), on « Vérification de systèmes dynamiques et paramétrés ». See also [\[BMO<sup>+</sup>08, CS07, CS08, Dim09\]](#) for related works. It should suit a theoretically-minded student with some taste for abstract algorithmic constructions like what is encountered in basic courses on recursion theory and computational complexity.

## Personne(s) encadrant le stage :

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## Références

- [BMO<sup>+</sup>08] P. Bouyer, N. Markey, J. Ouaknine, Ph. Schnoebelen, and J. Worrell. [On termination for faulty channel machines](#). In Susanne Albers and Pascal Weil, editors, *Proceedings of the 25th Annual Symposium on Theoretical Aspects of Computer Science (STACS'08)*, pages 121–132, Bordeaux, France, February 2008. IBFI.
- [CS07] P. Chambart and Ph. Schnoebelen. [Post embedding problem is not primitive recursive, with applications to channel systems](#). In *Proc. 27th Conf. Found. of Software Technology and Theor. Comp. Sci. (FST&TCS 2007), New Delhi, India, Dec. 2007*, volume 4855 of *Lecture Notes in Computer Science*, pages 265–276. Springer, 2007.
- [CS08] P. Chambart and Ph. Schnoebelen. [The ordinal recursive complexity of lossy channel systems](#). In *Proc. 23rd IEEE Symp. Logic in Computer Science (LICS 2008), Pittsburgh, PA, USA, June 2008*, pages 205–216. IEEE Comp. Soc. Press, 2008.
- [Dim09] J. Dimino. [Les systèmes à canaux non-fiables vus comme des transducteurs](#). Rapport de stage de M1, Master Parisien de Recherche en Informatique, Paris, France, October 2009.
- [DJS99] C. Dufourd, P. Jančar, and Ph. Schnoebelen. [Boundedness of Reset P/T nets](#). In *Proc. 26th Int. Coll. Automata, Languages, and Programming (ICALP '99), Prague, Czech Republic, July 1999*, volume 1644 of *Lecture Notes in Computer Science*, pages 301–310. Springer, 1999.
- [May03] R. Mayr. [Undecidable problems in unreliable computations](#). *Theoretical Computer Science*, 297(1–3) :337–354, 2003.