

## Master 2 Internship

### Mixing solving techniques on timing constraints with symbolic execution

Real time systems are systems in which the respect of timing constraints on computations is as important as the results of computations. The problem of analyzing time constraints for such systems has been studied for several years mainly in relation with the formalism of timed automata ([AD94]). Time automata are transition systems labelled by timing constraints over time variables (called clocks).

Among techniques to solve such constraints, we can cite techniques based on regions or zones ([ACD93], [YPD94], [HNSY94]...). Those techniques are resolution techniques specific to time. As such, they are often more efficient than considering clock values simply as real numbers in general purpose solvers. At the LISE laboratory, we have developed symbolic execution techniques for labelled transition systems with data represented in a symbolic manner, and we have adapted those techniques to handle constraints of timed automata ([EGL11], [BGLE12]). The purpose of the internship is to study the state of the art techniques in solving timing constraints with a particular emphasis on techniques based on regions or zones. The internship will be continued by studying how to integrate a selected relevant technique for timing constraint solving into a symbolic execution based testing algorithm. Implementations will be conducted as an extension of the symbolic execution tool Diversity developed at CEA LIST.

[AD94] Rajeev Alur and David L. Dill, A theory of timed automata. *Journal of Theoretical Computer Science*, 126(2):183–235, 1994.

[ACD93] Rajeev Alur, Costas Courcoubetis, and David L. Dill. Model-checking in dense realtime. *Journal of Information and Computation*, 104(1):2–34, 1993.

[YPD94] Wang Yi, Paul Petterson, and Mats Daniels. Automatic verification of real-time communicating systems by constraint-solving. In *Proceedings, Seventh International Conference on Formal Description Techniques*, pages 223–238, 1994.

[HNSY94] Thomas A. Henzinger, Xavier Nicollin, Joseph Sifakis, and Sergio Yovine. Symbolic model checking for real-time systems. *Journal of Information and Computation*, 111(2):193–244, 1994.

[EGL11] José Pablo Escobedo, Christophe Gaston, Pascale Le GALL P. Timed Conformance Testing for Orchestrated Service Discovery. 8<sup>th</sup> International Symposium on Formal Aspects of Component Software: FACS 2011, September 14-16 2011. Springer

[BGLE12] Boutheina Bannour, Christophe Gaston, Pascale Le Gall and José Pablo Escobedo, Off-line test case generation for timed symbolic model-based conformance testing, 24th IFIP Int. Conference on Testing Software and Systems: ICTSS'12, November 19-21 2012. Springer