Self-Stabilization in TVG
Master 2 Internship

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Keywords: distributed algorithms, time-varying graphs (TVG), self-stabilization, clock synchronization, unison.

Context: The availability of wireless communications has drastically increased in recent years and established new applications. Humans, agents, devices, and applications interact together through more and more heterogeneous infrastructures, in which they are required to work together in spite of their mobility. In such networks, entities (users, links, equipments, *etc.*) may join, leave, or move inside the network at unpredictable times. A common feature of these networks is their strong dynamics, meaning that their topology keeps continuously changing over time.

Several models taking into account topological changes over time have been proposed since several decades, *e.g.*, *evolving graphs* [XFJ03], *delay-tolerant network* [Fal03], *dynamic networks* [XFJ03] ... *Time-Varying Graphs (TVG)* [CFQS12] have been introduced more recently, with the aim to unify existing models, concepts, and notations. TVG are gathered and ordered into classes depending mainly on two main features: the quality of connectivity among the participating nodes and the possibility/impossibility of solving tasks.

Another approach to deal with dynamicity is to consider topological changes as faults. The concept of *self-stabilization* [Dij74] is known as a general technique to design a system that tolerates any arbitrary finite number of transient faults. A self-stabilizing (distributed) system, regardless of the initial state of the processors and messages initially in the links, is guaranteed to converge to the intended behavior in finite time. Self-stabilization may appear to be an appropriate approach to tolerate topological changes over time. Nevertheless, only a few work considered self-stabilization with highly dynamic systems.

Work To Be Done: This internship aims at proposing and studying self-stabilizing algorithms dealing with highly dynamic systems, modeled as TVG. More precisely, we will focus on a clock synchronization problem called *unison* [DP12]. Self-stabilizing solutions for this problem will be investigated in a class of TVG, where a bound on the temporal diameter is known by all processes.

In more details, this internship will consist of the following tasks: bibliographical study of the related work, algorithmic design, proof of correctness, and complexity analysis.

Prerequisites: Prerequisites for this internship include discrete mathematics, set theory, graph theory, first-order logic, algorithmic. Basic knowledges on distributed algorithms would be a plus, but is not mandatory.

Working Context and Contacts: This internship is proposed in the context of the ANR project ESTATE.[1] The student will be integrated in one of the following lab: VERIMAG (Grenoble), LaBRI (Bordeaux), or LIP6 (Paris).

To apply: Please contact **only one** of the following three centers.

Bordeaux: Colette Johnen (LaBRI, Univ. Bordeaux, `Johnen@labri.fr`)

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References

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[1] Enhancing Safety and self-sTAbilization in Time-varying distributed Environments; `wp-systeme.lip6.fr/estate/`.