

# Change-point detection in graph streams

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**Theme:** Graph Machine Learning

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## Description

Signal change-point detection is a long-studied problem with a plethora of applications. The classical formulation comes from the signal processing and statistics fields [1, 2], but more recently it has regained attention as more complex data types have emerged and became available. A quite new direction is the treatment of graph signals, which are signals observed over the nodes of a graph [3, 4]. Another direction is the treatment of the problem for graph streams [5, 6], which is the focus of this proposed work.

More specifically, in the latter setting there is an observed stream of graphs appearing over time, each one attributed with a timestamp. For instance, each graph may represent a summary of the activity that occurred in a system over a specific time-window, or in other words the state of the underlying system at some instance period. The problem of change-point detection in this spirit is to spot abrupt changes of structure within the graph instances. An attractive way to build such methods is to formulate a two-sample statistical hypothesis test between the set of graphs observed before and after a supposed change-point [6, 7, 8], which has different challenges depending if seen in an offline or online processing view.

This problem is general and consequently has several applications in monitoring industrial, social, or physiological systems. For instance, the graphs in the first case can encode the interactions between system components in a production unit, in the second case they can be message exchanges between individuals, and in the last one interactions or covariances of sensor measurements coming from an examined living subject that is examined. Finally, this approach can offer a fresh angle for the classical signal change-point detection, since one can construct graphs from typical signal observations and then operate in a graph-based fashion [9, 10].

**Keywords:** Change-point detection, segmentation, non-parametric methods, statistical hypothesis tests, graph streams, unsupervised learning.

## Indicative references

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**Doors open afternoon – 14 December 15h00-18h00:** The members of the Graph Machine Learning team will be happy to welcome the interested students at our lab. We can talk about this subject and the research opportunities at Centre Borelli. Please contact Argyris Kalogeratos to express your interest and allocate a time slot.