

Surveillance to detect emerging space-time clusters

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We are interested in monitoring incoming space-time events to detect an emergent space-time cluster as early as possible. Assume that point process events are continuously recorded in space and time. In a certain unknown moment, a small localized cluster of increased intensity starts to emerge. Its location is also unknown. The aim is to let an alarm to go off as soon as possible after its emergence but avoiding that it goes off unnecessarily. The alarm system should also provide an estimate of the cluster location. In addition to that, the alarm system should take into account the purely spatial and the purely temporal heterogeneity, which are not specified by the user. We propose a space-time surveillance system with these characteristics. We define a spatial-temporal version of the Shiryaev-Roberts statistic and adopt a martingale approach to derive the surveillance system properties. We define appropriately the average run length for the situation when there are clusters present in the data and illustrate the method in practice. The algorithm is implemented in a freely available stand-alone software and it is also a feature in a freely available GIS system.