Semi-parametric estimation of a spatio-temporal Hawkes process for modelling car accidents

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Room Benvenuti
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We propose a semi-parametric spatio-temporal Hawkes process to model the occurrence of car accidents over general domains. The overall intensity is split into the sum of a background component capturing the spatio-temporally varying intensity and an excitation component accounting for the possible triggering effect between events. The spatial background is estimated and evaluated on an approximation to the road network, allowing the derivation of accurate risk maps of road accidents. We ensure that the spatio-temporal excitation preserves an isotropic behavior and we generalize it to account for the effect of covariates.

The estimation is pursued maximizing the expected complete data log-likelihood using a tailored version of the stochastic reconstruction algorithm that adopts ad-hoc boundary correction strategies.

Two applications analyse car accidents occured on the London M25 Orbital in 2018 and on the Rome road network in years 2019, 2020, and 2021. Results highlight that car accidents of different types might exhibit varying degree of excitation, ranging from no triggering to an 8% chance of triggering one further event.

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