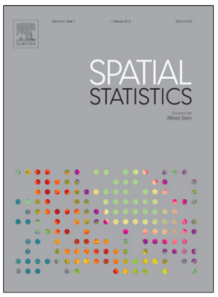

Estimating the intensity function of spatial point processes outside the observation window

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PII: S2211-6753(17)30035-0
DOI: http://dx.doi.org/10.1016/j.spasta.2017.07.008
Reference: SPASTA 250

To appear in: *Spatial Statistics*

Received date : 1 February 2017
Accepted date : 25 July 2017

Please cite this article as: Gabriel, E., Coville, J., Chadœuf, J., Estimating the intensity function of spatial point processes outside the observation window. *Spatial Statistics* (2017), http://dx.doi.org/10.1016/j.spasta.2017.07.008

Estimating the intensity function of spatial point processes outside the observation window

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Abstract. *Mapping the intensity of objects, as animal or plant species in ecological studies, is cumbersome as soon as these objects are not accessible by automated methods. The knowledge at large scale of the underlying process variability can then only be obtained through sampling and spatial prediction. Here, we aim to predict the intensity of a point process, at locations where it has not been observed, conditional to the observation using the best linear unbiased combination of the point process realization in the observation window. We show that the weight function associated to the predictor is the solution of a Fredholm equation of second kind. Both the kernel and the source term of the Fredholm equation are related to the second-order characteristics of the point process through the pair correlation function. We propose here several approximations to solve the Fredholm equation in order to obtain practical solutions and restrict the solution space to that generated by linear combinations of* (i) *step functions, which lead to a direct solution and* (ii) *elementary functions of a finite element basis, which provide a continuous approximation. Results are illustrated on simulations and to predict the intensity of Black Locust in a region of France.*

Keywords. *Fredholm equation; Finite element approach; Intensity estimation; Point process; Prediction; Spatial statistics.*

1 Introduction

In many applications the study window is too large to extensively map local intensity variations of the point process of interest since observation methods may be available at a much smaller scale only. That is for instance the case when studying the spatial repartition of a bird species at a regional scale, while the observations are made in windows of few hectares; or when detecting disease at the field scale, while observations correspond to spots of a few meter squares; or when mapping the presence of plant species at the catchment scale, while the observation scale is the meter square. The intensity must then be estimated from data issued out of samples spread in the study window, and hence, from a partial realization of the point process in this window.

We thus want to predict the intensity of a stationary point process conditional to its realization within the observation window W at any point $x_o \notin W$. In the sequel, this conditional intensity is called local intensity [10]. It allows us, through the conditioning, to take into account the second-order structure in