A computer implementation of the partition of the unity procedure and its applications to arthropod population dynamics. A case study on the european grape berry moth.

L. Javier Hernández*† Esteban García-Ruiz‡
M. Teresa Rivas* Vicente Marco§
Eduardo Sáenz-de-Cabezón* Ignacio Pérez-Moreno§
F. Javier Sáenz-de-Cabezón§

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Abstract

A new procedure based on partition of the unity has been developed to construct spatial approximation-prediction functions for discrete density functions. This Partition of the Unity Procedure (PUP) provides a family of approximation-prediction functions which depends on several parameters. In order to find the best function we have considered error estimators induced by the Vietoris simplicial set associated to an influence radius.

A computational implementation of these mathematical models has been elaborated to be applied to any kind of finite discrete data to obtain the parameters which minimize the approximation and prediction error.

These mathematical and computational methods (completed with biological, cultural, physical and chemical studies) are applied to study the population dynamics of the European grape berry moth Lobesia botrana, key pest of european and mediterranean vineyards. The main goal of this approach is to develop tools for a better understanding and management of this and other important pests. In our particular case study this is translated in the development of an Integrated Pest Management (IPM) program for the L. botrana in La Rioja in order to minimize economic, health and environmental risks.

The goal of our work is then, twofold: On one side we develop new procedures to construct approximation-prediction functions, and on the other side we give an example on the implementation of these methods for the study and management of L. botrana, developing a software accesible to the agents involved (from farmers to researchers).

The new technique can be applied to study different components of the population dynamics of arthropods in general. In the L. botrana

*Departamento de Matemáticas y Computación, Universidad de La Rioja, Spain
†Corresponding author
‡Departamento de Protección Vegetal, I.N.I.A., Spain
§Departamento de Agricultura y Alimentación, Universidad de La Rioja, Spain

case we studied (i) the analysis of the spatial distribution using density functions obtained by adults catches, (ii) the analysis of the development rate of the pest in the different parts of La Rioja, and (iii) the analysis of the spatiotemporal distribution and the calculus of the anual number of generations. This contribution focuses on the first parts being the analysis of the spatiotemporal distribution work under development from which interesting results have already been obtained.