Tilcara: An OO perspective to handle Continuous Fields in GIS

A. Zambrano, L. Polasek, S. Gordillo, J. Bazzocco,
G. Trilla, D. Cano, A. Lliteras

LIFIA-Facultad de Informática, UNLP
CC 11 (1900) La Plata, Buenos Aires, Argentina

+54 221 4228252
[arturo, pola, gordillo, jb, gtrilla, dcano,
lliteras]@sol.info.unlp.edu.ar

ABSTRACT

It is now usual that GIS applications need to define and handle continuous information. This is of extreme relevance in areas like meteorology and environmental applications. GIS do not have tools that allow the use of this type of information, which often prevents to make a complete analysis. In this work we present an application using object-oriented technology that allows us to manipulate continuous data.

Keywords

Geographic Information System, applied object oriented technology, continuous data.

1. INTRODUCTION

Field is an abstract concept used to comprehend several physical phenomena: electromagnetism, gravity, electrodynamics and other relativist mechanics. *Fields* are utilized to understand complex physical laws, which can be expressed in an accurate way by differential equations.

A *field* is a physic space-distributed amount, which takes a different value on each space point. The set of all possible values taken by the *field* is called *image*. The set of space point where phenomena can be measured is named *domain*.

A great variety of applications exists in which the required information are fields; for example any weather related application must have the capacity to analyze continuous phenomena, like the temperature, the humidity, among others. Surface and pollution are modeled as *continuous fields* in environmental research.

Due to the continuous nature of fields it is impossible to store the values corresponding to each space-point since they are infinite. This feature makes hard to handle that information. In this demonstration we present an application that deal with continuous information.

2. HANDLING CONTINUOUS FIELDS

The usual way to manipulate this kind of information is to make a sampling on the data: only some values associated to the phenomenon are taken in particular positions; the rest of the needed values are estimated through some estimation method; this estimation method uses the values of the sample as starting points for the calculation.

The sample can be organized in different spatial data models [1][2][5].

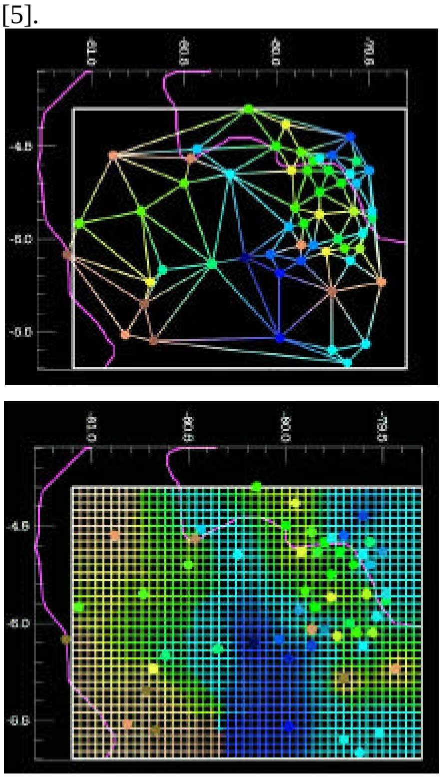

Figure 1: Two different SDM -TIN and Point Grid- for the same sample

In order to know the phenomenon value on non-sampled points it is necessary to interpolate using neighbor sampled values. The way used to interpolate is known as *estimation method*. It is possible to use several *estimation methods* with the same SDM. For instance, *k nearest-neighbors, b-spline* or *kriging estimation methods* can be used with *irregular point grid* SDM.

Nowadays, GIS do not provide built-in capabilities to handle *continuous fields*. Standard GIS are capable to represent the values of the sample; but, when it is necessary to make a query referring to a value of the function in a position that does not belong to the sample, the needed values are exported to some specific *calculus* application, then the produced values are imported.

Calculus is not a common work place for objects. Along decades, procedural languages have been the chosen tools for developing calculus applications. Besides, new GISs have benefit from object orientation. Our motivation was to integrate both *calculus* and GIS, to provide a complete OO model for GIS, and make continuous information available for future *query processing.*

We have extended an existing GIS architecture constructed at LIFIA [4] for handling continuous fields. Furthermore, we have developed the *Tilcara* application, using this OO-architecture. This application provides functionality to **define, manipulate** and **query** *continuous fields*.

In this demonstration we will show the definition process, it includes sampling, selection of SDM, an *estimation method*. Then, we will see how to manipulate *continuous fields,* i.e., change SDM and *estimation methods*, make complex operations among *continuous fields* [2] -like those used in environmental applications-, and make queries about the result of that manipulation.

The objective of this demonstration is to present a *real world* example of applied object orientation in an uncommon object domain.

3. ACKNOWLEDGMENTS

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