Towards a new Typology of Spatiotemporal Imperfection through a Study of Archaeological Excavation Data

C. de Runz, E. Desjardin

Context
Archaeology studies human culture through the recovery, the analysis and the interpretation of material remains and environmental data such as stamps, buildings, etc. Archaeologists construct the major part of their information through excavation, drilling, prospecting. Obtained at the excavation site scale, archaeological information is defined by ground information and by involved interpretations.

Issues
While Geographical Information System (GIS) is a classic in geography, we can denote a growing interest for its use in archaeology. This science, dealing with the past, partial discoveries and hypotheses, has to handle spatiotemporal information which is often incomplete and imprecise or uncertain. So, one needs to focus on the management of imperfection.

Approach
The aim of this article is to present a way to integrate the knowledge imperfection in the modeling of spatiotemporal data. We expose a refinement of the Fisher’s taxonomy in a spatial context to the archaeological one, based on a new typology of imperfection: 2 kinds of incompleteness (lack, gap) and 2 types of imprecision (vagueness, approximation).

Typology of imperfection in archaeology

Vagueness, Approximation, Discord, Non-specificity, Lack, Gap

Imprecision

The information imprecision is due to the vague or approximative aspect of the used semantic.

Vagueness
Data are subject to vagueness if they are defined using flexible or subjective knowledge, or if they are the consequence of the low resolution of observation tools.

Approximation
An information is approximate if the object attributes allow us to describe the object, according to a label “a”, as either “a”, “not a” or “maybe a”.

Incompleteness

We call incompleteness the fact that information is partially or not defined.

Lack
When information is missing (NULL value in the database), we deal with lack as, for instance, when there are archaeological objects for which the activity period is not defined.

Gap
The gap is due to the fact that objects in the database only represent parts of bigger objects and the set of database objects could not well define these bigger objects.

Taxonomy for modeling spatiotemporal imperfect data

Uncertainty

Well defined object: Error

Poorly defined object

Probability

Imprecision

Ambiguity

Vagueness

Fuzzy set theory

Approximation

Rough set theory

Discord

Non-specificity

Theory of Evidence

Fuzzy set theory

Bibliography


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