Mapping the Virtual Geography of the World-Wide Web

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“It’s easy to get lost in cyberspace. Indeed, navigating the World-Wide Web is much like driving cross-country without a road map: If you don’t know where you are, it’s tough to get where you’re going.”

Jacqueline Henry

A map for virtual spaces

This project proposes a new framework for presenting information about virtual locations to the users of the World-Wide Web.

The maps provide the equivalent of

A bird's-eye view of the World-Wide Web landscape

A directional sense similar to roadmaps

A means by which to understand distances

A tool for demographic analysis

A teleportation system

Maps

A method has been developed and implemented to create a representation similiar to geographical maps. Usual maps have three basic attributes:

Scale

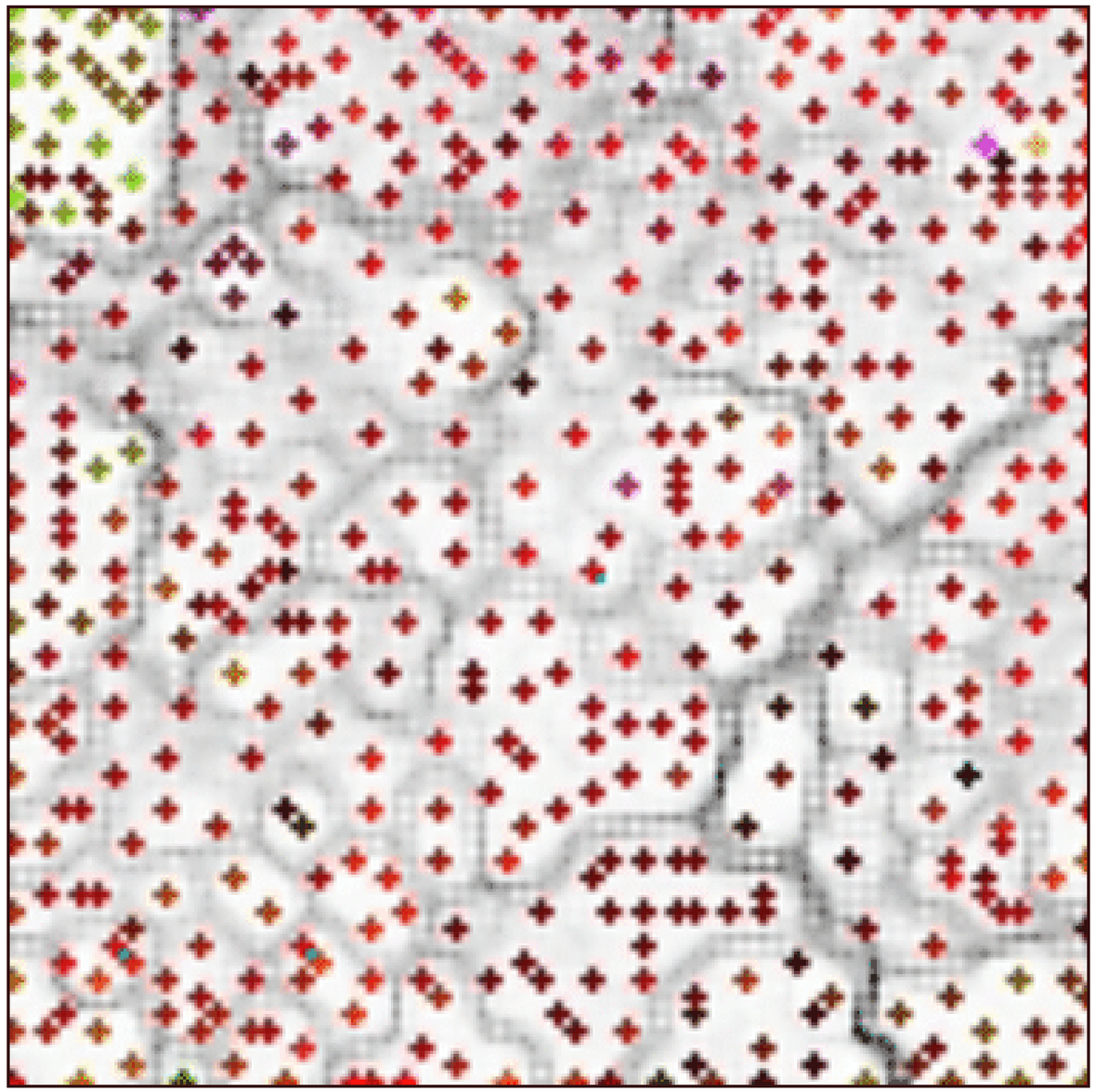
Scales rely on the ability to calculate distances.

Projection

The transformation of the curved suface to a flat plane.

Symbolisation

Maps use symbols for representing features, places and other location information.



Resources are represented with colored crosses
Relief is depicted using grayscale
Distances among resources depends upon the relief

Scale

Using hypermedia links, a simple metric, providing the capability to calculate distances, can be created:

The distance between two resources can be defined by the length of the shortest path between them.

It becomes possible to immerse each resource as a point in a high dimensional space, the distances between relations being relative to the topology of the World-Wide Web;

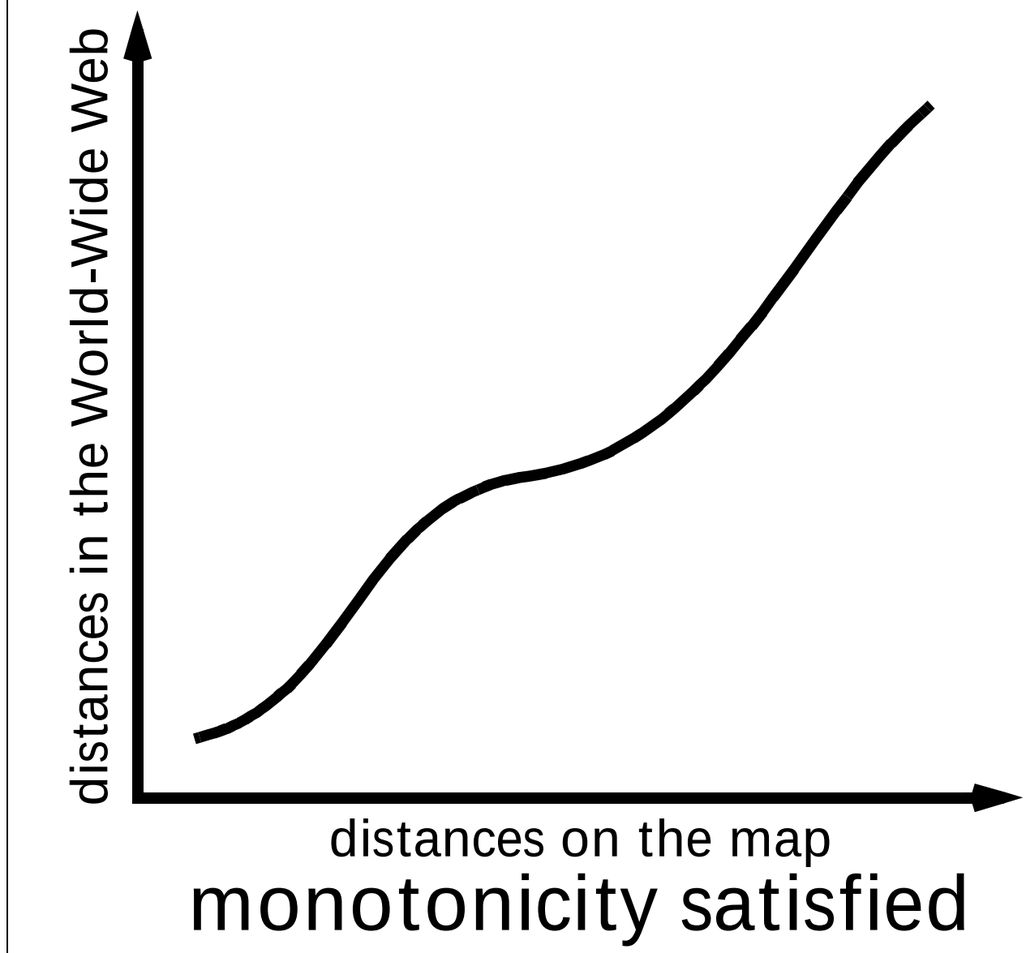
two resources which have a direct link will be close and two resources with no relations, even through their neighbor-hood, will be far away.

Projection

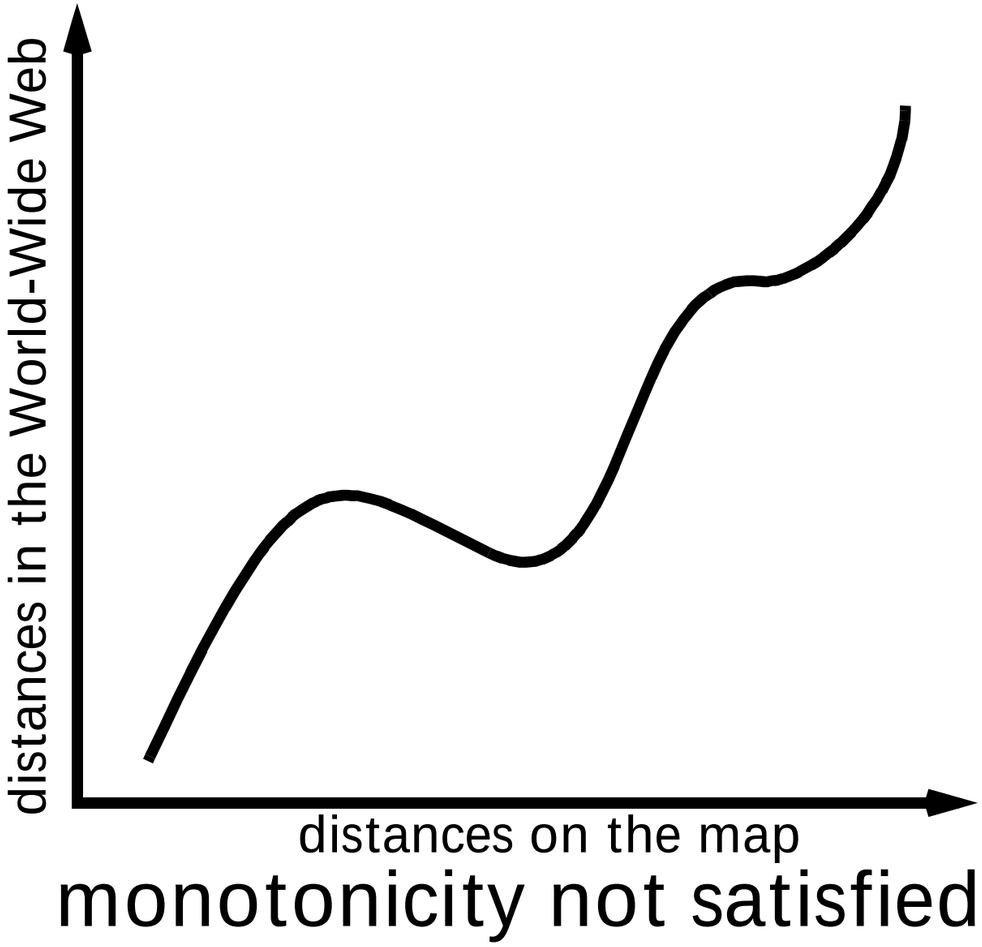
It is clear that a high dimensional space such as the one we created for the World-Wide Web cannot be visualized and thus its dimensionality has to be reduced.

This will create the ability to map any resources onto a lower dimensional space, while maintaining their order of proximity.

Although popular methods for doing such non-linear dimensionality reduction exist, a fairly new method called the self-organizing map algorithm has proved to outperform them.



monotonicity satisfied



monotonicity not satisfied

Only the rank order of the dissimilarities is preserved by the transformation.

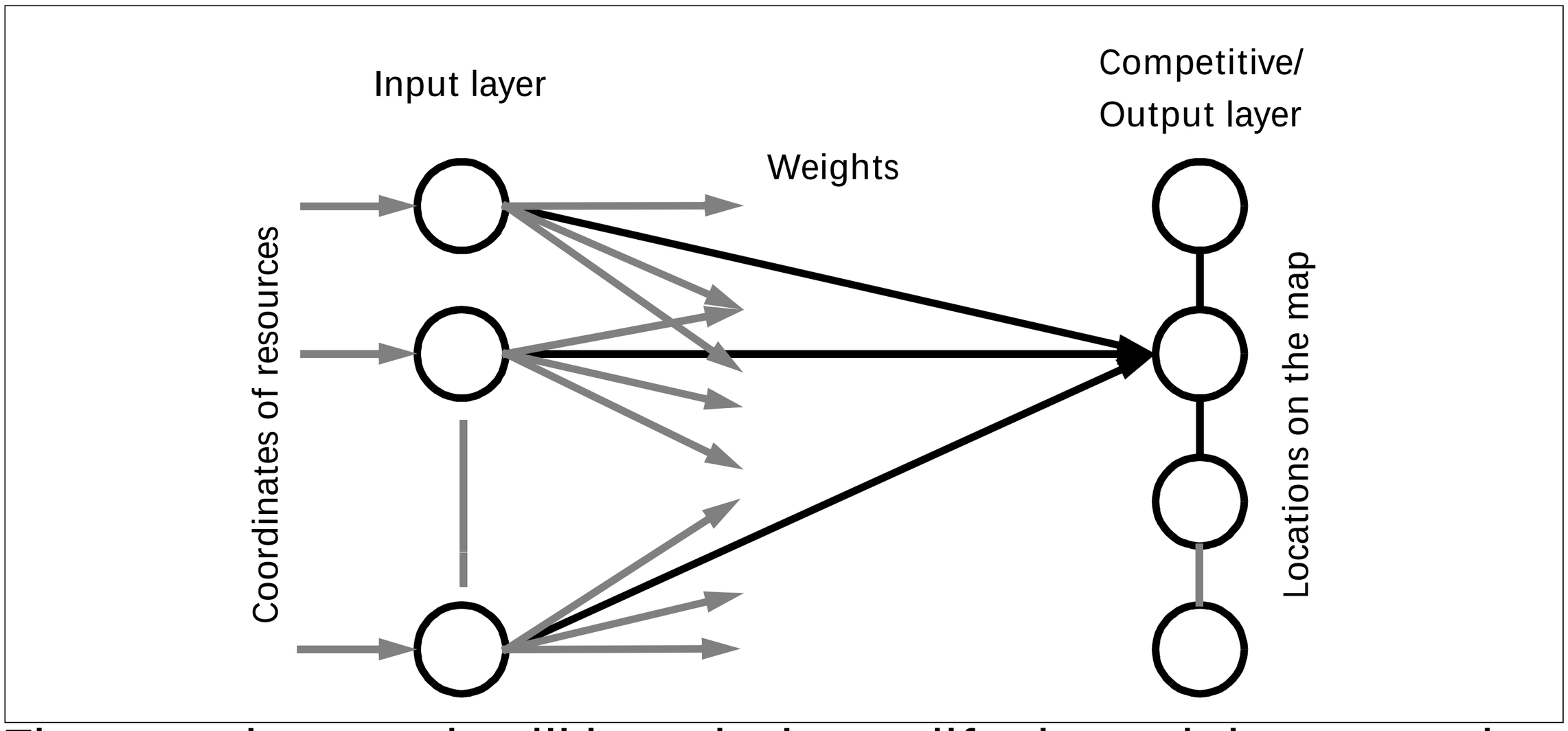
Therefore, the projection must obey the monotonicity constraint.

Self-organizing maps

The self-organizing map algorithm, first introduced by Kohonen, is an unsupervised (self-organizing) neural network inspired from biology.

The most interesting property of this neural network is that the feature map (output layer) preserves the topology of stimuli according to their similarity.

This result is a computational intensive task. Fortunately, a decomposition into small tasks is possible and a parallel implementation can easily be developed.



The neural network will iteratively modify the weights to produce a map in the output layer that will exhibit as best as possible the relationship of the topology of the World-Wide Web.

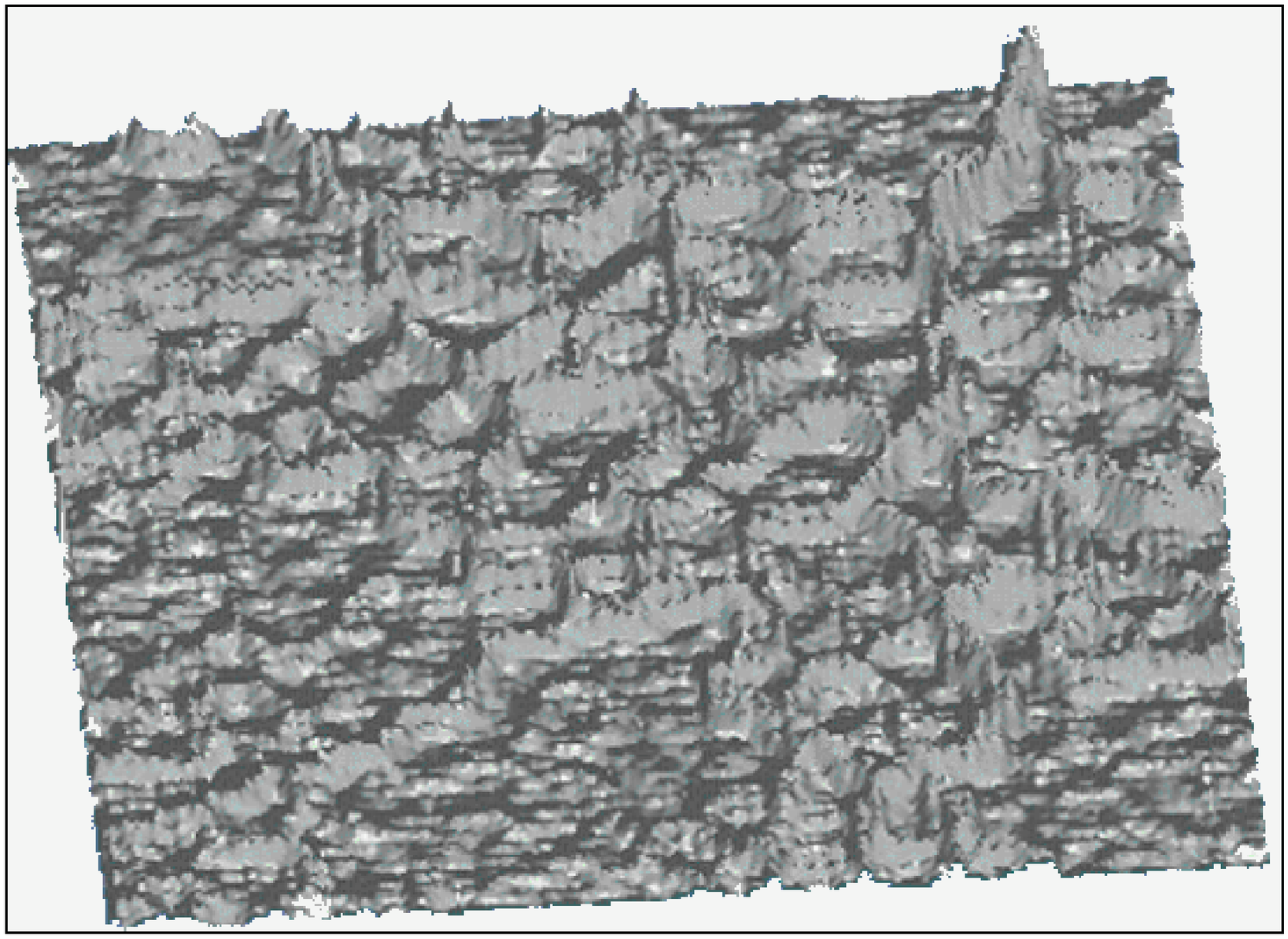
Symbolisation

A color is assigned to the "inhabited" locations and its value is determined by some empirical data such as the number of links, the directory level and the clustering level.

The representation provides a way to differentiate the distances between locations. In fact, the relief can be interpreted like mountains and ravines.

The power of this representation can be clearly seen in the potential it has to provide clustering visualization:

Similar resources are usually located in valley, which permits a quick way to analyse the various "political" regions



Integration in the World-Wide Web

Using real information about resources available in the World-Wide Web and their connective structure, various maps have been constructed.

The visualization, comprising some interaction possibilities, is made available directly on the World-Wide Web using dynamic pictures and sensitive maps, which enable visualization of the user's location and direct retrieval of the resources represented on the maps.

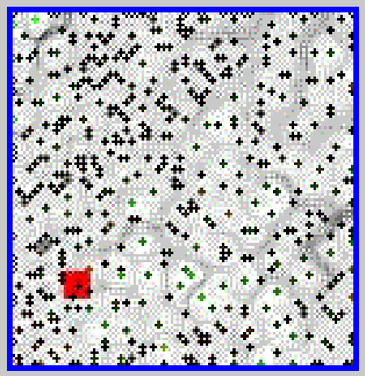
Integration in the TecfaMOO

The TecfaMOO is a Webbed MOO, i.e. a multi-user virtual reality system that combines the power of the World-Wide Web with the flexibility of the MOOs (Multi-user dungeon, Object Oriented).

First trials with TecfaMOO have shown that the map, with its ability to show our location and to be teleported to any place on the MOO, is a very valuable tool for users to explore what is "going on" in such a multi-user virtual environment.

TecfaMOO - a Virtual Space for Educational Technology, Education, Resarch & Life

Location | Home | Body | Programmer's Manual | Applications: mail | Do it!



Daniel's Office

You see an modern office, quit standard in appearence. You see a blackboard on which you can leave a note ('writeb .....'). 'Out' will lead you back to the Atrium.

Contents:

Machine a chocolats, TV, VCR, WWW Box, Mother, and Luc

Obvious exits:

atrium (to The Tecfa Atrium), tower (to Tower), island (to island), and pangea (to PanGea Hall)

Possible enhancements

Metric

Other dissimilarity coefficients or empirical knowledge can be used to calculate distances (e.g. correlations, time).

Symbolization

For example by displaying the directions similar of the flow of water in a ocean.

User interface

Integrating visual information about already visited locations with a special marking for the location we come from.

Parallel implementation

Distributing the workload on a parallel computer.

For further information

http://heiwww.unige.ch/girardin/cgv/

or

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