

Cognition of dynamic geographic process: combining geo-referenced phenomena simulation with real-time dynamic change monitoring

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Different from discrete representations of man-made objects (e.g. houses, bridges, tunnels), continuous geographical phenomena in 3D space is in flux, which is also not exactly the same as the world of human seeing and knowing. The representation, analysis and cognition of dynamic geographical phenomena (e.g. spatial distribution of a chemical in the air) is thus complicated by the fact that many dynamic phenomena cannot be directly observed in reality by people, requiring the assistance of augmented/auxiliary means; it is also impossible to measure everywhere these phenomena and as a result the geographic process models are especially need to be introduced in 3D space.

Considering the limitations of human understanding of the real world in space and time, the animated and dynamic virtual environment is generally offered to enhance or augment the cognition to the dynamic process. Based on the virtual geographic environments, we have experienced some works for air pollution simulation and 3d dynamic representation: with the real-time data captured from the reality by GeoSensor Networks and integrating geographic process models to quantitatively simulate dynamic geographic phenomena, which have been combined together in the geo-spatial cognitive environment to explore geographic mechanism as well as improve human spatial cognition about geographic rules.

However, many specific issues are need to further discussed and verified:

(1) Fusion of reality and virtuality oriented dynamic / real-time air pollution monitoring: In this step, how to distribute monitoring sensors for geographic process is more effective? That is, we should consider the problems: difficult to get the accurate pollution sources; what are the factors that influence the topological sensor networks?

(2) What's the appropriate representation for these dynamic phenomena? For air pollution, in order to improve the air pollutant rendering of "fuzzy boundary volume object", we have designed a solution of a particle system wrapped in pollution boxes in 3D space. Hugo Ledoux also suggested the 3D Voronoi diagram for geo-field representation, could we confirm the appropriate data structure? In addition, people may not see the air condition intuitively in the real world, but in the virtual environments, the monitoring data can be visualized in different colors, shapes or types, which will help people to cognize the phenomena more easily, but what's the suitable forms?

(3) How to efficient integration and management of heterogeneous geographic process models into virtual environment in standardization? Its very important for collaborative analysis with different levels users such as professional scientists, government officers and general public.

(4) What are the different cognitive processes that are invoked for different types of virtual environments? help people to find the differences in human cognitive responses to the dynamics in the real geographical space and the virtual geographic environment, then give different representations which may be appropriate for the different situations. And then compare the influences of cognition in the "pure" virtual environment and the virtuality-reality fusional virtual geographic environments.