3D Geovisualization of Travel Patterns Using GIS and GPS Data

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This paper examines the use of interactive 3D geovisualization methods in representing individual space-time paths using trip data collected by the Global Positioning Systems (GPS). The trip data were collected from a sample of individuals using GPS over a six-day period in Lexington, Kentucky, U.S.A. This large set with detailed space-time data of all the trip records (with one space-time coordinate recorded per second) was then analyzed through the time-geographic perspective formulated by Hägerstrand (1970). Trips made by an individual in a day are represented as 3D space-time paths within a 'space-time aquarium'. In a schematic representation of the 'aquarium', the vertical axis is the time of day and the boundary of the horizontal plane represents the spatial scope of the study area. Individual space-time paths were portrayed as trajectories in this 3D aquarium. Although the schematic representation of the 'space-time aquarium' was developed long ago, it has never been implemented using detailed real activity-travel diary data.

Difficulties of this method include the need to convert a large set of the 2D trip data into a "3Dable" format that can be used by existing visualization software, and the lack of comprehensive geographic data for representing complex geographic objects of the urban environment in 3D. However, the recent incorporation of 3D capabilities into GIS packages and the availability of contextual geographic data of many metropolitan regions have greatly reduced these two difficulties. In this study, three contextual geographic data layers of the Lexington metropolitan area were incorporated into the GIS database. Results reveal differences in travel behavior among various gender/ethnic groups. For instance, trips for women who have no children under 16 were largely undertaken using highways and major arterials. Further, there are some regularity as indicated by the repetition of similar trip patterns in more or less the same time throughout the 6-day survey period. This suggests that activity-travel behavior can be captured in terms of specific space-time patterns through 3D geovisualization.