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Human Behavior Analysis during Remarkable Flood Episodes: Proposition of Automatic Survey Protocols based on Mobile Technologies (TRACES Project)

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Context

We aim at improving our knowledge on human activities during remarkable flood episodes, in order to measure individual exposition to those risks and to evaluate alert and prevention actions about those typical risks. Moreover, we would like to improve our understanding of consistent criteria underlying individual choices in mobility: this knowledge could allow us to better model human activities. The “TRACES” project, gathering complementary teams in geography, geomatics and human-computer interaction of the Joseph Fourier University of Grenoble (France), aims at determining best suitable methodologies to analyze mobility modes and patterns.

In France, since the 70’s, standard surveys, so called “household travel surveys”, exist to acquire daily urban movements in big cities: a set of movements made by the members of a household during a 24h-period are collected, via interviews, with the help of a provided paper questionnaire. The known weaknesses about those surveys are the following:

- Movements are not exactly georeferenced: they are only connected to predefined elementary regions for the study. The size of a region is usually more than one block.
- Complementary information about the movements –date, duration, etc.– is acquired at the end of the survey’s period, i.e. a posteriori: this process may lead to omission of information by the user, increased by the length of the period of surveying.
- No contextual information about the movements is acquired.

Actually, we aim at proposing new protocols to survey people, especially during specific periods such as remarkable flood episodes. Our proposition relies on two observations. On the one hand, we face an improvement of precision, reliability and endurance of mobile technologies (GPS loggers/trackers, mobile phones with built-in GPS) that motivate us to use them for new protocols: first of all to acquire human tracks (needed but low semantic information) and then to acquire interactively high semantic information about human movements. On the other hand, an activity-based approach should be proposed to handle or consider human movements not only as successive segments, but also as complex sequences: it requires integrating spatio-temporal constraints and taking social and environmental interactions into account to dynamically analyze human activity. Based on both observations, we will face methodological and technical issues. We specify these issues in the two following sections.

Methodological Issues: Which suitable methodologies to analyze human mobility pattern in the context of flood risks?

Our methodological issue concerns the best way to analyze human mobility patterns in the specific context of remarkable flood episodes. We first have to get information about human mobility in such a critical context: Where are human people during a flood episode? How and why they move in their geographical area? We thus need to get their geographical position at every moment of a studied period. We also have to get information about their habits in terms of: where do they live? Where do they work? Which travel have been made, with who and how? And finally what is the motivation of stopping there or there? Our purpose is to describe new survey protocols to answer to these questions and to improve the knowledge acquired by standard surveys, as “household travel surveys”. Next, we could analyze and compare mobility patterns and answer to: does the meteorological context (i.e. potential risks for life) influence the mobility patterns? Is there an individual adaptation of the daily mobility by bad weather conditions? For these new protocols, we would like to use mobile technologies to refine the spatial and temporal information on a person every moment of a period.

Technical Issues: Do current mobile technologies help to improve data acquisition?

A lot of research works exist about the acquisition and the analysis of data about mobile objects (Laube et al. 2007) and especially human (Asakura et al. 2003, Millonig et al. 2009).

In our context of proposition of new protocols, we have first to choice between:

- The way to acquire human tracks: GPS logger/tracker device or mobile phone with built-in GPS;
- The way to retrieve human tracks: data storage on GPS followed by the retrieval of GPS, or, real-time data retrieval through mobile phone connection;
- The way to filter human tracks to obtain analyzable/visualizable tracks from rough tracks.

We propose to rebuild the user’s activity in analyzing multi-source spatio-temporal data: user’s tracks (georeferences and temporal references), geographical data (topographical, main networks), environmental data (risk zones) and various points of interest. Contextual information could be added by the user, through GIS interfaces after the period of tracking survey (in case of GPS use) or interactive questionnaires on mobile phone interface (in case of mobile phone use), in order to enhance semantic information on their tracks. We also face some geovisualization issues of human tracks and especially spatio-temporal representation issues to make understandable by the user his trace and his interaction with his environment.

Therefore, the rebuilding of users’ activities relies on automatic interpretation: filtering and reconnecting to territory and time methods (spatial and temporal GIS analysis). We are currently working on filtering tracks and spatially analyzing tracks: we are developing methods to characterize the human tracks in detecting physical and semantic stops, change of modes, etc. with an in-house software system (Java framework). In parallel, we are describing survey protocols, which are going to be experimented soon.