DEVELOPMENT OF AUTONOMOUS TOPOLOGICAL NAVIGATION OF THE TRANSPORTATION VEHICLES

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Autonomously navigated transportation vehicles represent an important evolutionary step for increased level of security in accomplishment of different tasks that varies from passive observance to active researches. To acheive this goal transportation vehhicles should be independent and have an ability of effective context interpretation – constant tracking and understanding ability of the enviroment is an important step. Supporting new probability approach in the context of tracking by transportation vehicles based on sensors management systems calculates quotient validities in operational environment that is external in relation to mechanical field of vision.

The core of this research is the utilization of topological maps instead of standart metric maps in navigation of transportation vehicles.

Standard processes of navigation need major arithmetic operations, huge and bulky on-board computers because they use metric maps of the neighborhood. As oppose to regular methods, the navigation program uses simple sensors and absolutely no metric maps and it bases on immediate sensor estimate of topological models.

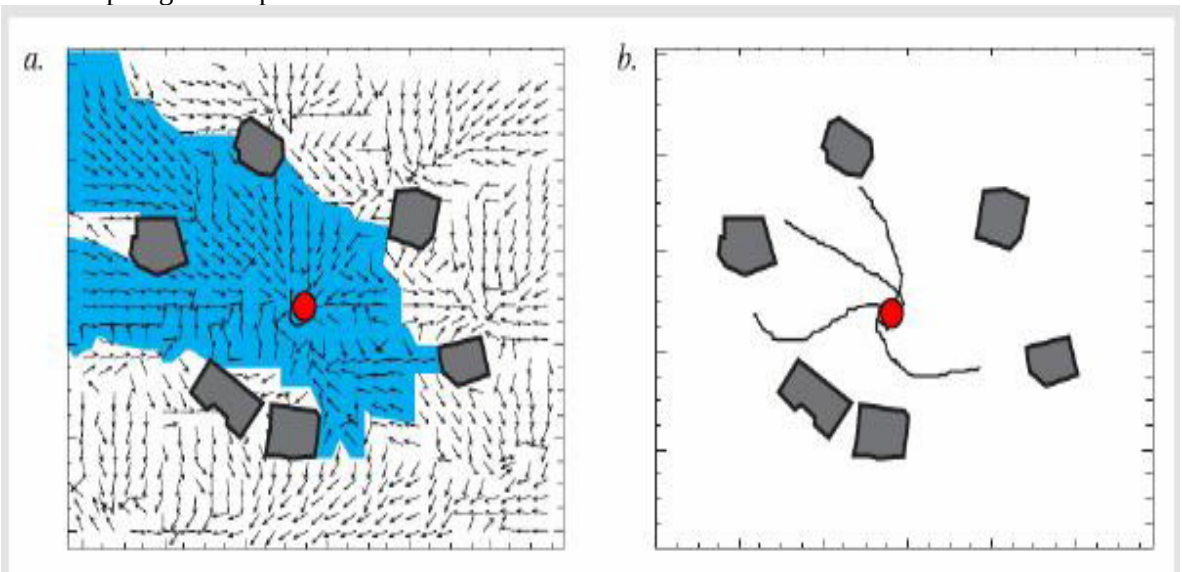
Standard maps contain information that is tied up to coordinates X and Y. Topological maps contain neighborhood description through objects indication and space relations in between them.

Example of standard map: Building 12, coordinates 10km-20km

Building 20 coordinates 10-25 km.

Corresponding topological description: Building 20 is located 5km to the east from Building 12.

Topological map will consist from the tree (columns) with junctions (objects) and ribs (relations).



On the picture a) big figures are target objects and in the center the red point is an automobile. On the picture b) indicates the ways to the target points.

There is one more important variation, where ribs do not contain space relationship, but directions to transportation vehicle on how to move from one junction to another. There are several types of such directions – they are named strategies. In this case, transportation vehicle does not know its exact location, but knows how to move from one object to another.

Exemption from space information map lets to cut resources on its storage and map analysis.

Transportation vehicle determines:

a) At what junction it is located – without using any coordinates, sensors and equipment, just by recognizing the junction - the object in the area, for example, special building. Then transportation vehicle defines b) how it should move in order to reach the target point. This information the navigation system can a) determine itself, if topological map contains space relations between junctions (objects) or b) get it directly from the map (from tree rib/column) if it contains any.

For example, navigation system of transportation vehicle uses information that the building 20 is located 5 km to the west from building 12 (current junction) and determines itself where to go. West can be determined by the compass.

You can ask yourself – do you know your way from home to work in coordinates? Very unlikely. However, we know our way very well because we use topological thinking. Intersection A, then to the left, then to the right all the way to intersection B, then turn to the left again, down to the house with the white front.

Presented autonomy system has a number of advantages before traditional satellite, distinguished by its independence from weather and positioning on the satellites orbit, does not require, as it was mentioned before, huge athmetic operations, but at the same time has a number of deficiencies or complications.

The board computer of transportation vehicle before being able to orient freely in the area, needs to input a big load of information about location of the certan object and directions how to move from one object to another, also at the process of scanning the area the problems could happen with finding key objects, changing conditions of the environment (for example, level of brightness). Here a huge help is being contributed by the usage of stereocameras - knowing the vision angle, we can determine the distance to the target. Anyway, the task of determination of the same object by each camera and following synchronization of their «views» remains important, which is complicated in the scale of real time.

Autonomous topologic navigation can be utilized differently, from simple object movement to parking assistance.

Literature

1. H. Gonzalez-Banos and J. Latombe. AVENUE (Autonomous Vehicle for Exploration and Navigation in Urban Environments) San Francisco, CA, USA (2000) 415 p.