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# Intelligence Enhancing of Dual Use Bicycle Routes Designing and Planning System Simulator

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## Abstract

Due to limited funding it is important to understand which bike path network would be more efficient and important for municipality and cyclists. The multi agent-based (MAS/ABM) simulator VeloRouter allows bicycle paths occupancy simulation, but quality of the results depends on the data confidence and capacity.

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## 1. Introduction

The European Commission established the specific European Transport Specific Programme<sup>1</sup>, which promotes clean transport i.e. cycling as a part of integrated intermodal transport system. This means that bike paths network must correspond to the transport schema. Therefore, it is important to understand which bike path is more efficient. Cyclists are interested in justified selection of the route to avoid the problems for travellers related with terrain, quality of route and occupancy during the travel time.

FP7-ICT-2011-7 FUPOL project<sup>2</sup> gave the opportunity to understand the needs of potential customers. The market analysis involves significant amount of different bicycle routes planners<sup>3</sup>. However these products mainly offer the capability of publishing cycling routes, but do not provide functionality necessary for municipalities to

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design suitable bicycle path network.

In conformity with the requirements Skopje Bicycle Inter-Modality Simulator (<http://www.fupol.eu/en/news/skopje-bicycle-inter-modality-simulator>)<sup>4</sup> was created to find a useable solution for bicycle stations deployment in the City of Skopje. The system helps the municipality of City of Skopje to improve the scheduling and resource planning. The above-mentioned simulator can be considered analogous to VeloRouter, however simulation algorithms and results are focused on the needs of a specific large municipality rather than individual cyclists.

The multi agent-based bicycle path network and exploitation simulator VeloRouter<sup>5</sup> is designed in the Repast Symphony environment and uses OpenStreetMap spatial data. The technology is adapted to both the needs of municipalities and cyclists. VeloRouter provides municipalities with bicycle path discussion on the web and crowdsourcing opportunities. The municipality is interested in some basic question: Is the offered cycling route map satisfactory? This is recognized by summarizing potential comments and statistics analysis. Behind basic the second question is: Which potential cycling route sections should be built first? Each agent is a cyclist or a group of cyclists that move on a chosen route considering route occupancy, traffic restrictions and the quality of the route. The cyclists have the opportunities not only to send a message to the municipality, but also to publish his routes for public discussion. The cyclists want to know what the occupancy of a route will be in certain meteorological conditions on a specific date, as well as if the route is suitable for the travellers group i.e. terrain etc.? MAS/ABM based occupancy simulator can give the answers on the questions mentioned and provides monitoring of bicycle path network development scenarios and changes management.

## 2. Simulator data base influence on justified decision making

There are two ways of route planning in VeloRouter: with and without occupancy simulation, which can be switched off to reduce waiting time for data processing. Occupancy simulation depends on quality of the data base.

### 2.1. Occupancy simulation model in VeloRouter

The MAS/ABM occupancy simulation model can be specified by two components: data and algorithm.

Input data involves:

- Number of cyclists
- Type of day
- Start time
- Weather probability (summer or winter)
  - Summer day with/without precipitation
  - Winter day with/without precipitation
- Route (start and end points)
- Weather conditions (specific date and hour)
  - Temperature (C)
  - Snow (mm)
  - Rain (mm)
  - Atmospheric pressure (hPa)
  - Wind
    - Speed (m/s),
    - Direction (meteorological degrees)

Output data involves:

- Route occupancy per minute (data structure)
  - Route section (ID)
  - Day
  - Minute

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