

# Multimodal Dynamic and Stochastic Routing

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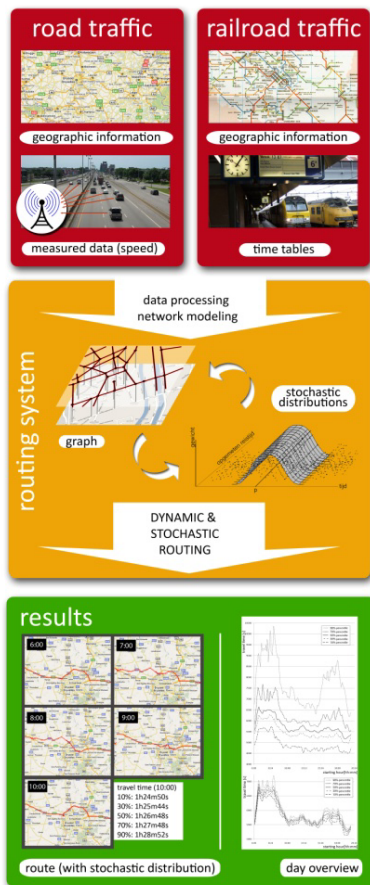
We present a novel algorithm to route both dynamically and stochastically in a transportation environment. An overview of the complete developed transportation system is given in **Figure 1**.

Both road and railroad data is collected (in real time) in order to build a multimodal network with, assigned to each link, a stochastic distribution of the travel times. This network enables the novel algorithm to route both dynamically and stochastically, resulting in routes with stochastic distributions of their travel times and a stochastic overview of the travel time of a specific route during a day.

The algorithm presented here is based on the algorithm of Dijkstra, with novel data structures. A stochastic distribution is denoted by  $n$  values that represent  $n$  predefined percentiles of the distribution. It can be shown that 5 values, namely the 10%, 30%, 50%, 70% and 90% percentiles, are sufficient for our routing purposes. In order to make the algorithm dynamic, a stochastic distribution is needed for every time of the day. The shortest (i.e. fastest) route now is dependent upon the departure time. Moreover, labels in the algorithm of Dijkstra are no longer single values, but stochastic distributions. Two paradigms were used to combine stochastic distribution: the pointwise sum (completely correlated links) and the convolution product (completely uncorrelated links). It can be shown that the actual distribution lies somewhere between the two distributions obtained with these (extreme) methods.

Experiments have shown that this algorithm results in reliable travel times, dependent upon the time of the day. It can be shown that the distributions obtained with the pointwise sum are more stretched out than those obtained with the convolution product.

This routing system has been implemented and can be experimented with at <http://dna.intec.ugent.be/mdsr/>.



**Figure 1. Overview of the system**