

## The Problem of Distribution of Park-and-Ride Car Parks in Warsaw

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### Abstract

The development of cities and agglomerations brings new problems to be solved. One of them is the excessive road traffic and the related air pollution. Heavy traffic causes congestions and thus increases the pollution level, because one of the most significant sources of air pollution are car exhaust gases. It is known that the public transport produces less pollution per one passenger than the private one. On the basis of this fact the idea of the Park-and-Ride (P&R or P+R) was developed, where commuters travel to the borders of the city by their cars and from there they continue their trip by public transportation. In this work, we will concentrate on finding the best localizations for P&R points.

Our approach is composed of two steps. In the first step, a number of communication hubs is selected where P&R can be located (feasibility analysis). In the second step a subset of hubs is chosen to actually have P&R points built (commuters' convenience analysis). We solve the P&R location problem on the first step using some aspects of the Hub and Spoke method by applying a specialized evolutionary algorithm. As the problem of the second step is rather small, we propose to have it solved by experts.

*Keywords:* Park and ride, hub and spoke, evolutionary algorithm.

### 1. Introduction

The dynamic development of the road traffic in big cities and agglomerations causes several problems. Congestion and car exhaust gases are among the most important of them and are the main reason of increasing air pollution.

It is well known that public transport produces less pollution per passenger than the individual one. Based on this fact the idea of the Park and Ride System (P&R) was developed.

The Park and Ride system offers free parking places for commuters which want to change from a private car to public transport. This system leads to many advantages for the commuters and their cities ([1], [4]):

- reduction of congestion and traffic jams in the city