A Strategic Study on Managing Public Bike Sharing Systems by Demand Profile and Temporary Manpower Allocation

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In this thesis we first present how to formulate a network design problem for bike sharing systems that selects the best locations for constructing rental sites and the best amount of bikes as well as racks to be installed in each site with minimum total cost satisfying a given service level. To mimic the actual biking traffic between rental sites, we force the bike flows to be proportional to their designed patterns obtained by a surveyed demand profile. Based on the proportion, we propose a nonlinear mixed integer model and solve it by a two-stage Particle Swarm Optimization (PSO) algorithm.

We then propose linear programming models to allocate temporary manpower on rental sites to take care of excessive returned bikes, and seek volunteer bikers on some specific origin-destination routes to balance the demands on bikes and empty racks at stations, so that the designed quality of service can be achieved with minimum cost.

We finally introduce a static repositioning mathematical programming model that seeks the best routing and load/unload plans for each repositioning vehicle with balanced workload. We present two static repositioning models based on different forms of flow balance constraints, and observe that the model based on assignment problem has better performance. We also propose PSO algorithms for solving the static repositioning problem of larger size.

***Keywords*:** bike sharing systems ； network design, temporary manpower, static repositioning, mathematical programming

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