

## Optimizing Snow Plowing Operations in Urban Road Networks, Phase II

**Purpose:** Snowstorms significantly disrupt mobility and safety, yet most cities use static snowplowing plans with simple allocation schemes which limits the efficiency of the snow removal process. This research develops an alternative approach using a system for real-time dynamic optimization of municipal snow plowing operations.

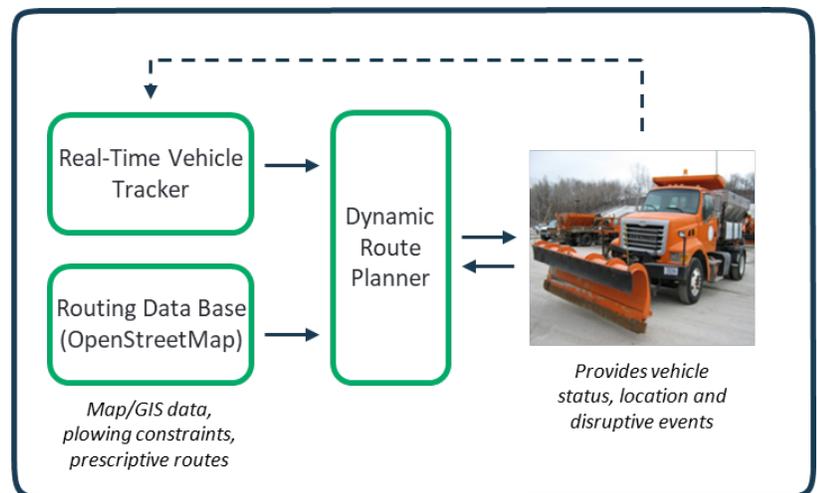
**Approach:** The CMU route-planning algorithm generates routes by considering a set of street segments to be plowed, a larger set of street segments that can be used for moving from one plow job to the next if necessary, the set of vehicles that are available to handle plow jobs, along with their plowing constraints and the location of other relevant resources.

The algorithm begins by generating an initial route and repeatedly making revisions based on different conditions to produce new alternative routes. At each step, the quality of each new route that is generated is evaluated, and the search continues from the best routes found so far.

**Key Findings:** In comparison with the City of Pittsburgh's current system, RouteSmart, the two variations of CMU's route planner, Make Span Minimization (focused on minimizing route duration) and Lexicographic Prioritized Search (focused on plowing main roads first) produced routes that had fewer U-turns and faster completion times than RouteSmart.

A real-time, in-vehicle navigation app was also pilot tested by Department of Public Works personnel using an existing city route.

**Conclusion:** Plowing plans should match current storm conditions and resource availability (instead of assuming a single pre-generated plan based on expected conditions), and the plans should be dynamically revised in real time in response to unexpected circumstances. From this approach, two complementary technologies (a snow plow route planning algorithm and an in-vehicle real-time navigation app) have been developed to provide more efficient solutions for snow removal.



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### Project Record:

- [ppms.cit.cmu.edu/projects/detail/4](http://ppms.cit.cmu.edu/projects/detail/4)

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