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Fuzzy cost-profit tradeoff model for locating a vehicle inspection station considering region constraints

Key words: Cost-profit tradeoff, Credibility theory, Fuzzy simulation, Fuzzy programming, Genetic algorithm

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Motivation

- Use a fuzzy cost-profit tradeoff approach to locate a vehicle inspection station considering regional constraints, so as to describe its actual condition.

- Disadvantages of existing methods:
  - Do not consider regional constraints
  - Do not consider tradeoff between cost and profit
  - Do not consider uncertainty of expert opinions

Model (I)

Fuzzy expected cost-profit tradeoff model with regional constraints:

$$\min E(C)$$

subject to

$$\begin{cases} E\left[\sum\sum b_j \xi_{ij} - \sum e_j\right] \geq B^0, \\ h(x,y) \leq 0, \quad g(x,y) \geq 0, \\ x \in (x_l, x_u), \quad y \in (y_l, y_u), \end{cases}$$

Model (II)

Fuzzy chance-constrained cost-profit tradeoff model with regional constraints:

$$\min \overline{\overline{C}}$$

subject to

$$\begin{cases} \mathrm{Cr}\left\{\sum\sum \xi_{ij} c_{ij} d_{ij} \le \overline{\overline{C}}\right\} \ge \alpha, \\ \mathrm{Cr}\left\{\left(\sum\sum b_j \xi_{ij} - \sum e_j\right) \ge \overline{B}\right\} \ge \beta, \\ h(x, y) \le 0, \quad g(x, y) \ge 0, \\ x \in (x_l, x_u), \quad y \in (y_l, y_u), \end{cases}$$

Results of model (I)

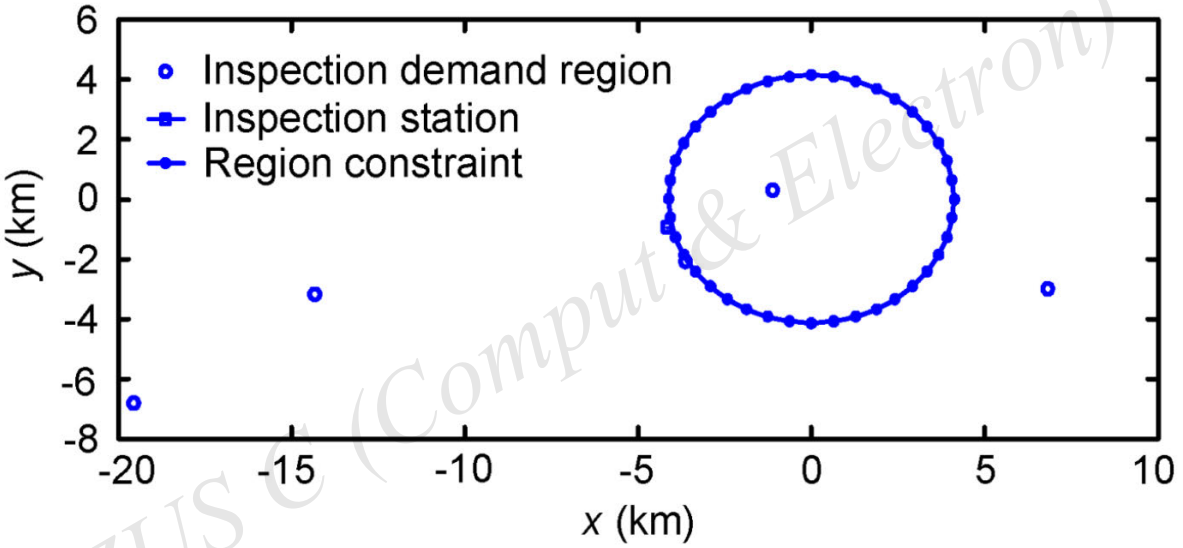

Fig. 2 Plane distribution graph for locating a vehicle inspection station

Results of model (II)

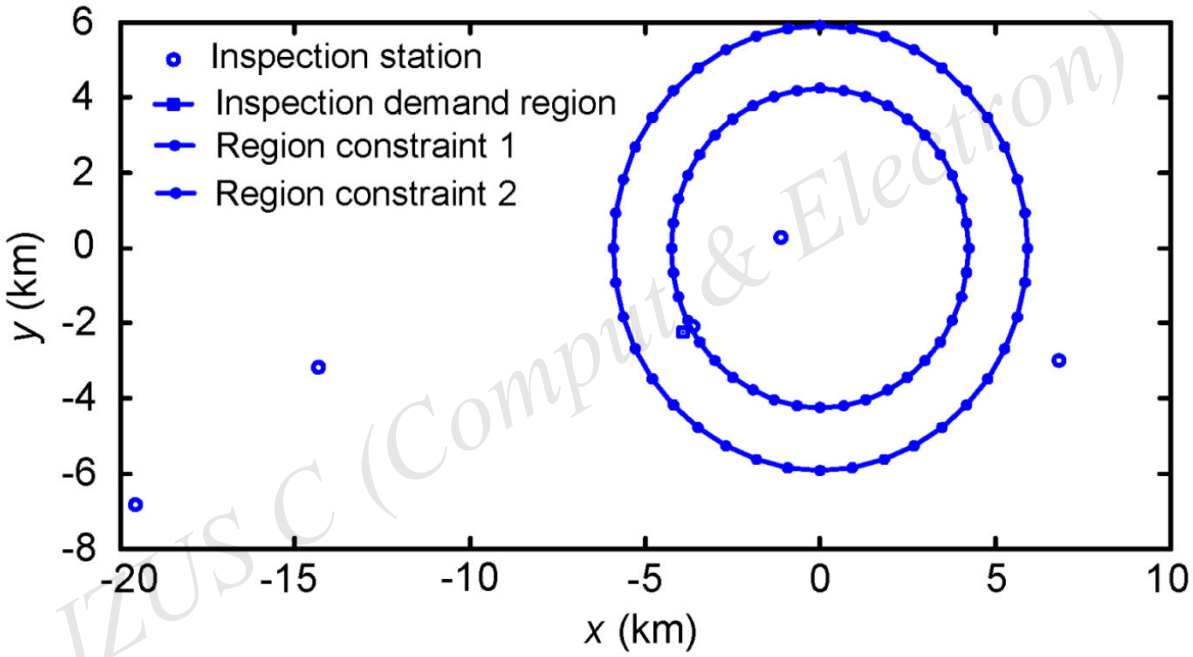

Fig. 3 Plane distribution graph for locating a vehicle inspection station

Comparison results

We compared the our results for the example with those of the previous method:

Case	pop_size	pr_c	pr_m	Quasi-optimal solution	
				Proposed method	Deterministic method
1	40	0.3	0.3	326 839	319 213
2	25	0.2	0.4	327 703	321 316
3	35	0.2	0.3	327 047	319 213
4	40	0.2	0.3	326 515	319 244
Average				327 026	319 746