An Evolutionary Optimization Approach for Disaster Relief Supplies Distribution

**Case Study**

Peru is a country located in the west coast of South America. Since the Peruvian coast is located between the Nazca and South American tectonic plates, earthquakes in Peru are common occurrences. The last major earthquake, which measured 8.0 on the moment magnitude scale, hit the central coast of Peru causing 519 casualties. Despite the considerable relief effort, the response was unfortunately chaotic and marked with a lack of coordination and information.

**Exact Approaches**

- Branch-and-Bound Algorithms
- Branch-and-Cut Algorithms
- Set-Covering-Based Algorithms

**Heuristics**

- Limited exploration of the search space
- Good quality solutions
- Modest computing times
- Can be extended to account for diverse constraints

**Vehicle Routing Problem**

\[
\min \sum_{i \in V} \sum_{j \in V} c_{ij} x_{ij}
\]

subject to

\[
\sum_{j \in V} x_{ij} = 1 \quad \forall j \in V \setminus \{0\} 
\]
\[
\sum_{i \in V} x_{ij} = 1 \quad \forall i \in V \setminus \{0\} 
\]
\[
\sum_{i \in V} x_{0i} = K 
\]
\[
\sum_{j \in V} x_{ij} = K 
\]
\[
\sum_{i \in S, j \in S} x_{ij} \geq r(S) \quad \forall S \subseteq V \setminus \{0\}, S \neq \emptyset 
\]
\[
x_{ij} \in \{0,1\} \quad \forall i,j \in V 
\]

**Metaheuristics**

- Simulated Annealing
- Tabu Search
- Ant Algorithms
- Neural Networks
- Genetic Algorithms
- Greedy Randomized Adaptive Search Procedures

**The Genetic Algorithm**

1. Generate initial population
2. Repeat
   1. For each species
      For \(i = 1\) to \(n\)
      Select two parents from current species
      Generate a new solution with the crossover operator
      Perform a local search with the mutation operator
      Add the new solution to the current species
      Remove the \(n\) worst individuals using the evaluation function
   2. Exchange the local best solutions across species
3. Until convergence criteria or maximum number of generations

**Evaluation**

- Effort
- Located
- Scale
- Moment
- Search
- Modest computing times
- Can be extended to account for diverse constraints

**Discussion**

- P. Toth and D. Vigo. The Vehicle Routing Problem, 2002
- R. Alva. Plan de despacho para la distribución de ayuda humanitaria en caso de un terremoto de gran magnitud en Lima Metropolitana y Callao, 2014

**References**

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