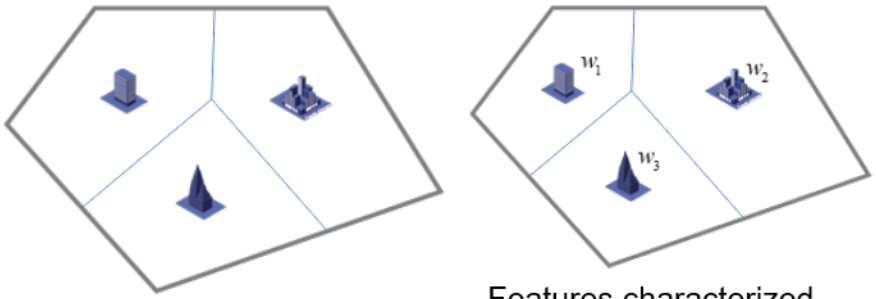
Power diagram based algorithm for the facility location and capacity acquisition problem with dense demand

Yuyou YAO, Wenming WU, Gaofeng ZHANG, Benzhu XU, Liping ZHENG

Frontiers of Computer Science, DOI:10.1007/s11704-022-0582-2

Problems & Ideas

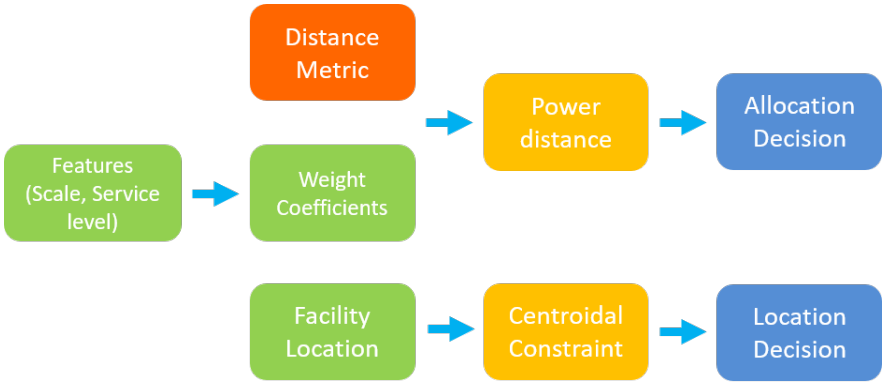
- Problems of Location-Allocation Problem with Dense Demand:
  - Previous studies focus on the allocation of customers to facilities based on the Euclidean distance.
  - In addition to distance, some features of facilities (such as the scale, service level) may affect the allocation of customers.
- Ideas: These features of facilities are characterized as weight coefficients.
  - The facility with a larger weight coefficient will service a larger region, which indicates more customers will be attracted.
  - Combining the distance and attraction of facilities, the allocation decision of customers is determined based on the power distance.
  - Minimize the transportation cost by optimizing the location of each facility to the center of the corresponding service region.



Euclidean Metric

Features characterized (Power Distance Metric)

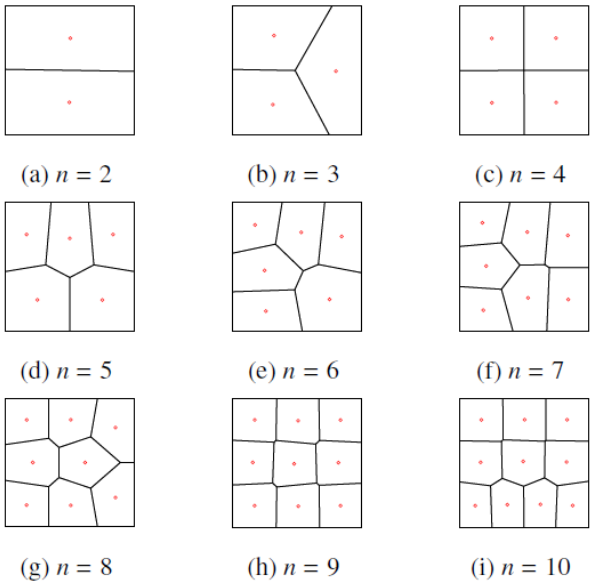
Comparison allocation results in the Euclidean distance metric and the power distance metric.



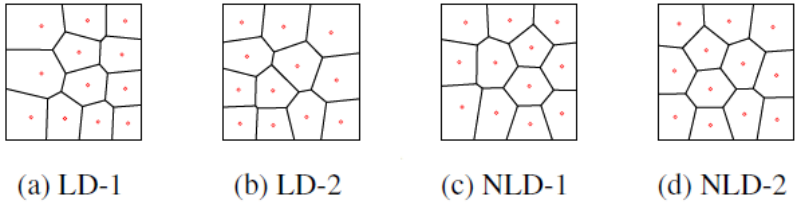
Allocation decision and location decision based on power distance metric.

Main Contributions

- Contributions:
  - A continuous model for the facility location and capacity acquisition problem is introduced, where the transportation cost is a non-linear function of the Euclidean distance.
  - The power diagram is employed to determine the allocation decisions with general dense demand.
  - A novel iterative algorithm is developed to solve the facility location and capacity acquisition problem with dense demand.



Computational results for different number of facilities with uniform dense demand.



Experimental results for five facilities with various demand densities.

Performance comparison to other methods with various demand densities (in seconds).

Methods	Allocation strategy		Demand densities		
	VD[1]	PD[2]	UD	LD-1	NLD-1
Iri et al. [3]	✓		4.230	4.536	4.457
Murat et al. [4]	✓		99.890	115.24	103.75
Bourne et al. [5]		✓	3.321	/	/
Proposed method		✓	2.198	2.199	2.538

[1] VD: Voronoi diagram [2] PD: power diagram