FACULTY OF ENGINEERING AND ARCHITECTURE

INDUSTRIAL SYSTEMS ENGINEERING AND PRODUCT DESIGN

ANALYSIS OF MINIMAL CLEARANCE AND ALGORITHM SELECTION EFFECT ON PATH PLANNING FOR AUTONOMOUS SYSTEMS

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Background:

- Electronics Engineering,
- Master in Management Information Systems

Research interests:

- Autonomous Robotics, Optmization Algorithms, Deep Learning

Actual Projects working:

- Path planning algorithms to optimize Deep sea mining using autonomous robots
- Global path planning for autonomous unmanned aerial vehicles in urban mobility

AGENDA

- MOTIVATION
- FUNDAMENTAL CONCEPTS
- RESULTS
- CONCLUSION AND FUTURE WORK

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MOTIVATION

- Path Planning is a central topic in autonomous robotics
- There are many path planning algorithms in the literature
  - The goal is to find the best path between the starting and goal point
- There are some conditions for which these algorithms fail or become less efficient in finding the searched path
- Is it possible to determine under what conditions these algorithms tend to fail or become less robust?
  - There are no studies that analyze the effects of constraints using data analysis

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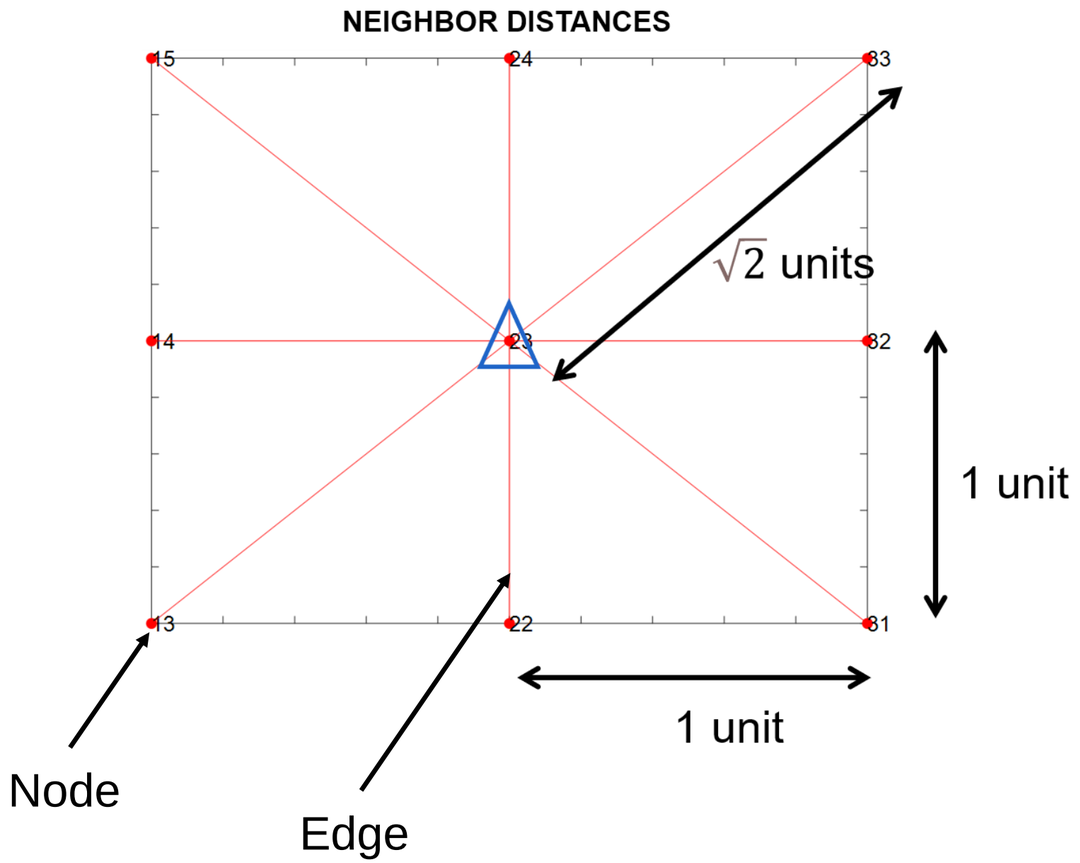
FUNDAMENTAL CONCEPTS.
DISCRETE REPRESENTATION OF THE MAP



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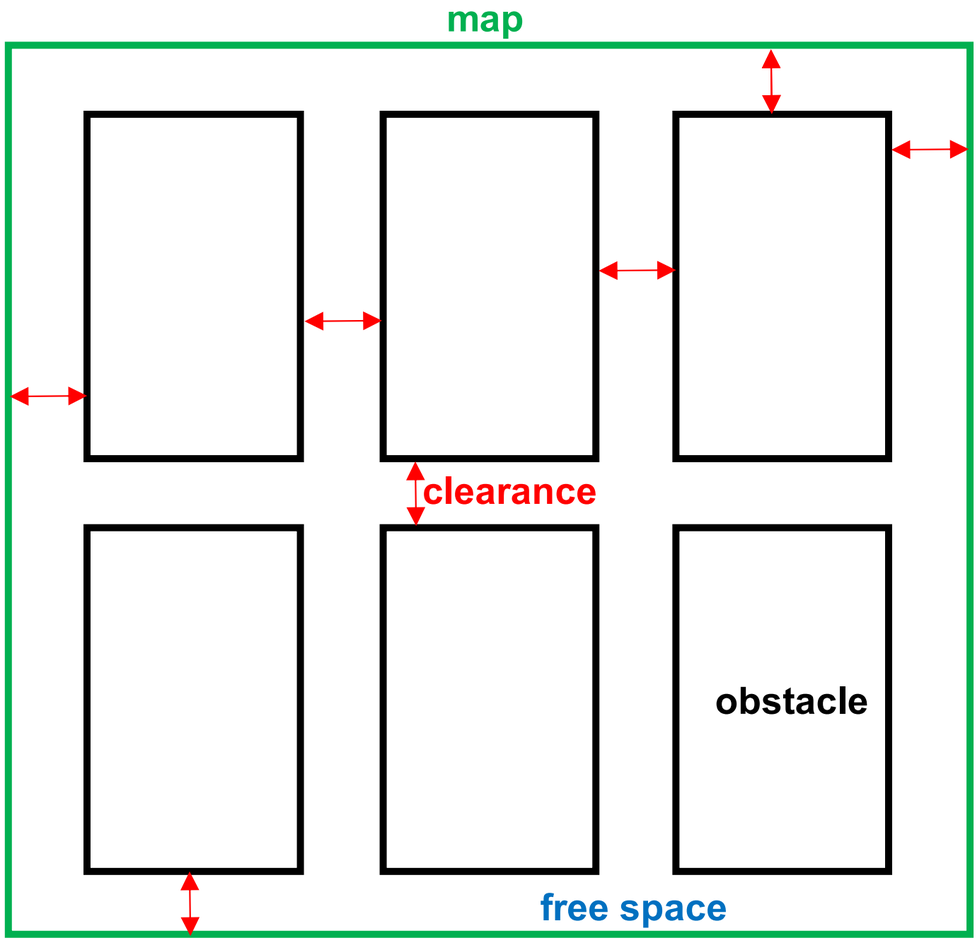
FUNDAMENTAL CONCEPTS. CLEARANCE CONCEPT



- Configuration space
  - Obstacle Space
  - Free Space
- Space among some obstacles

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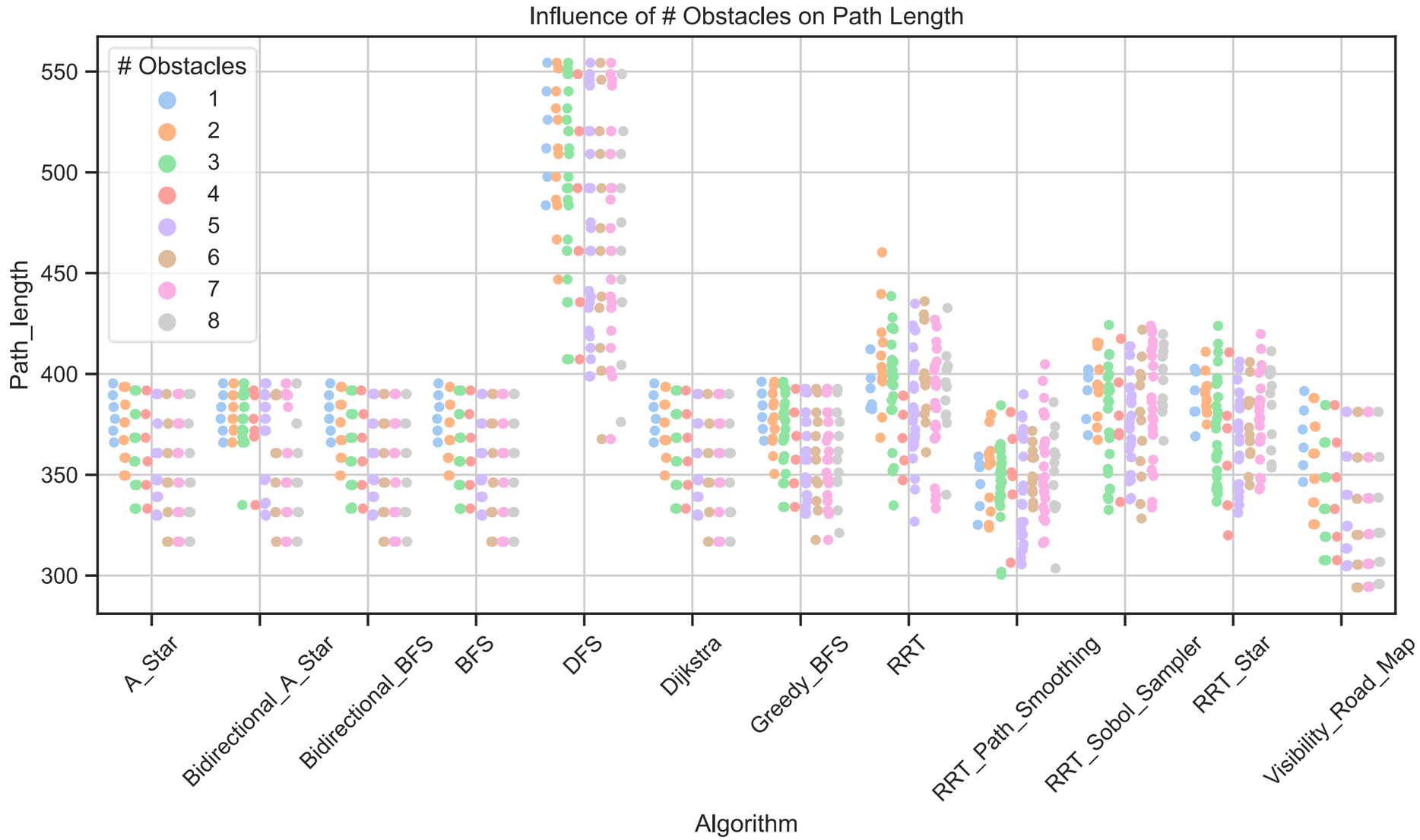
FUNDAMENTAL CONCEPTS. METRICS

- Metrics used in the study
  - Path length.- Length of the path obtained by the algorithm
  - Number of Iteration.- It is the number of processes executed in the nodes of the free space during the task of finding the path between the start node and the destination.

RESULTS. #OBSTACLES EFFECTS



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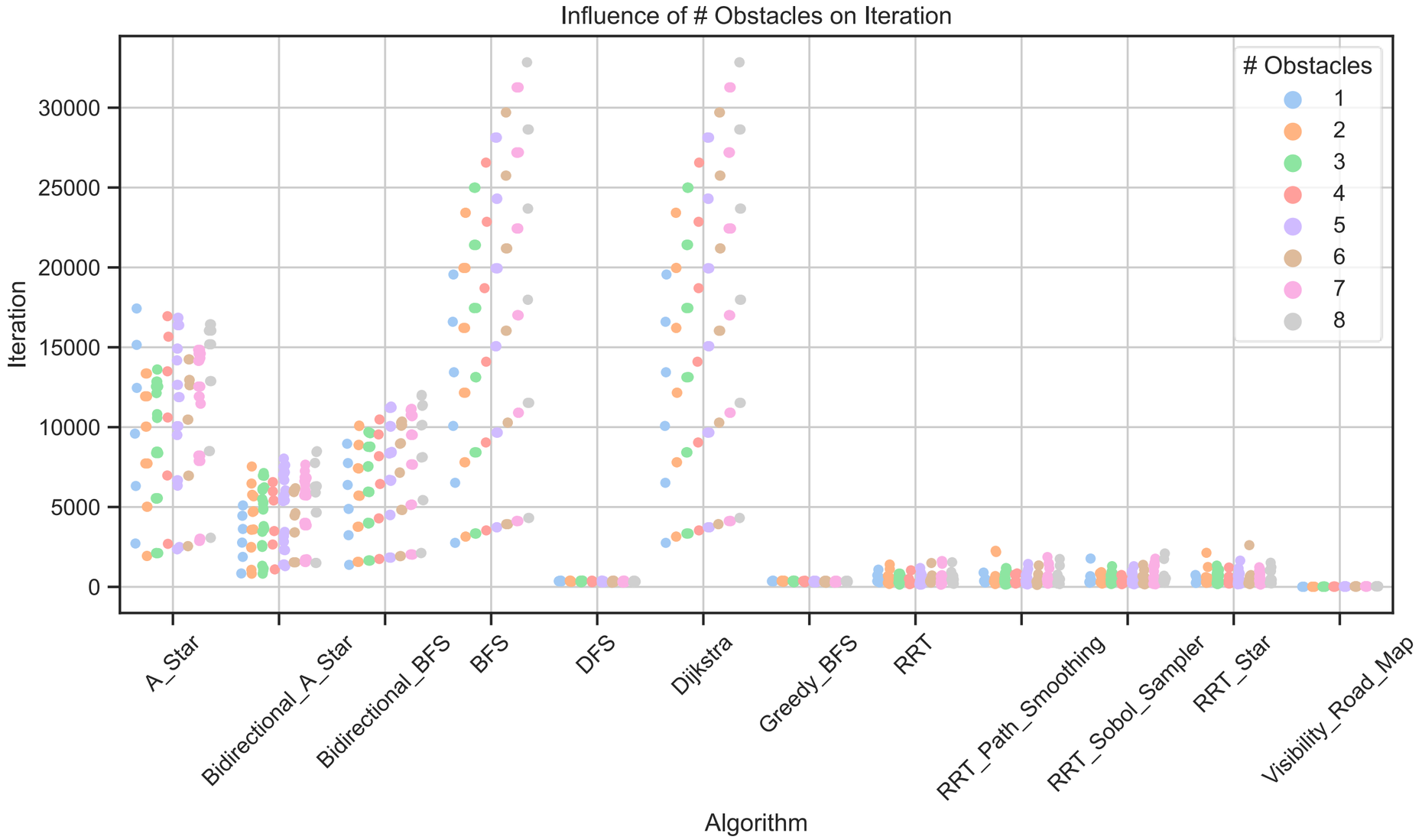
RESULTS. #OBSTACLES EFFECTS



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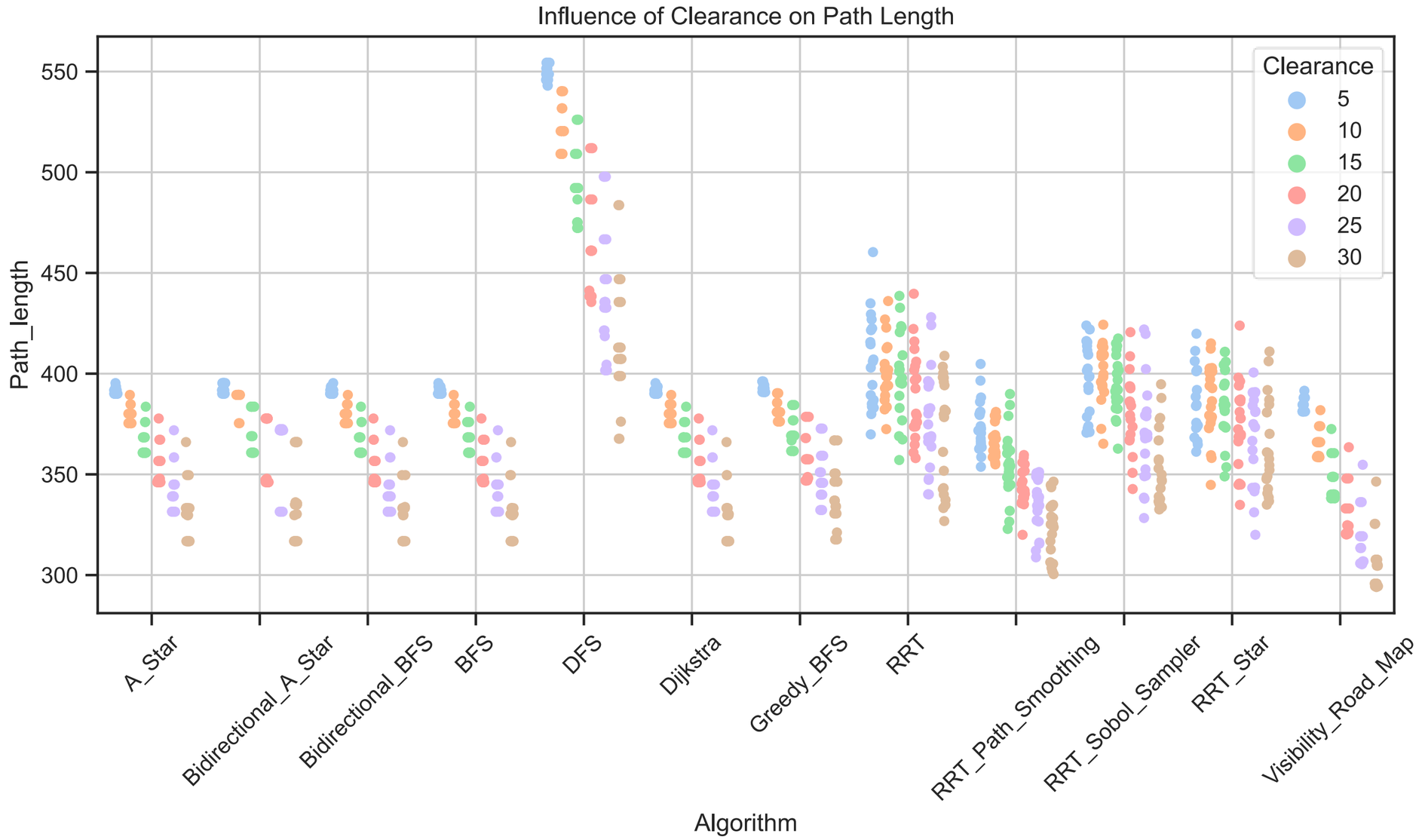
RESULTS. CLEARANCE EFFECTS



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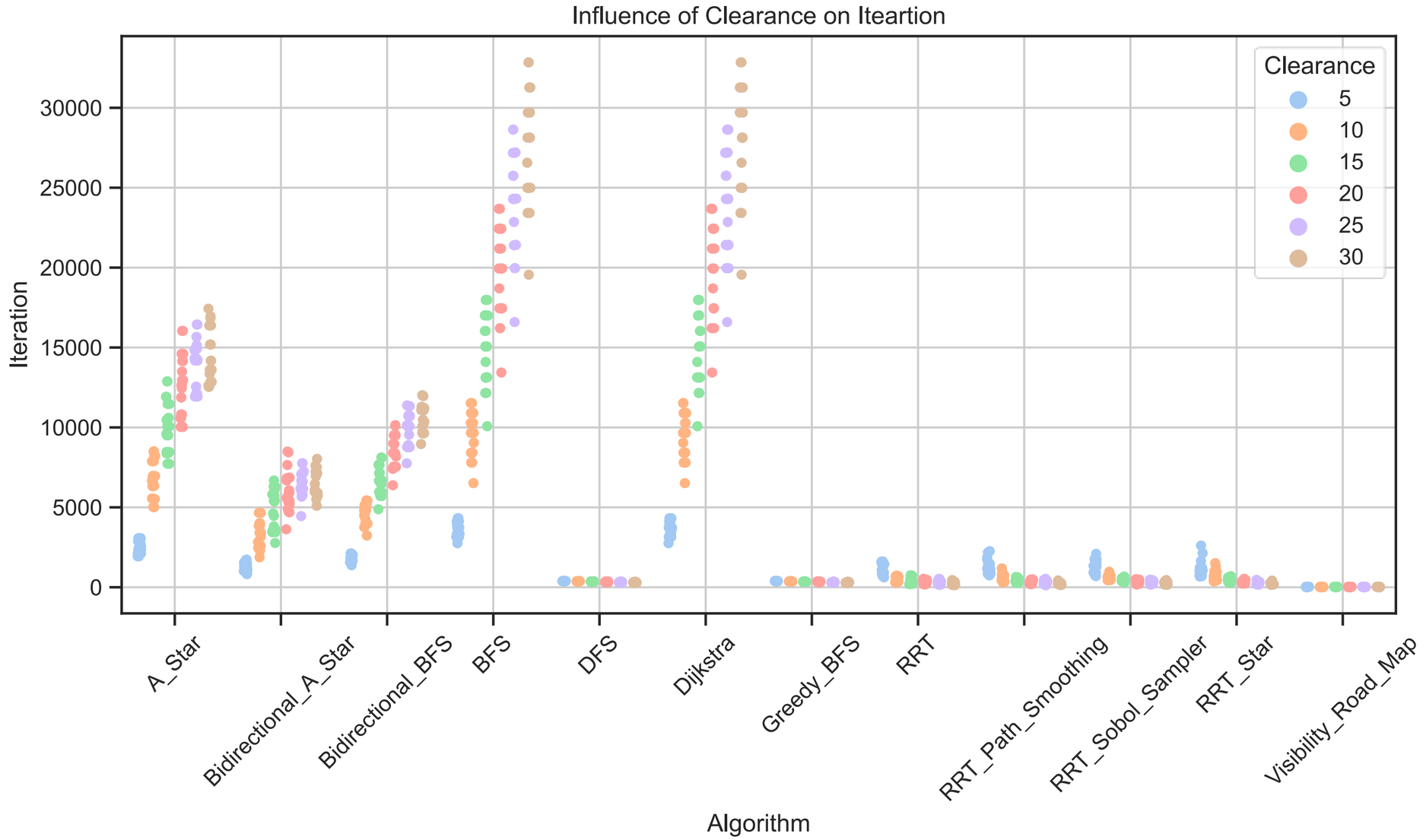
RESULTS. CLEARANCE EFFECTS



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RESULTS. IMMUNITY ANALYSIS

TABLE II

SUMMARY OF ALGORITHM IMMUNITY WITH THE CONSTRAINTS

	Clearance Immunity		# Obstacles Immunity	
Algorithm	**Path Length**	**Iteration**	**Path Length**	**Iteration**
Visibility Road Map	no	yes	no	no
A*	no	no	no	no
Dijkstra	no	no	no	no
BFS	no	no	no	no
Bidir BFS	no	no	no	no
Bidir A*	no	no	no	no
RRT*	no	no	no	no
Greedy Best First Search	no	no	no	no
RRT Sobol Sampler	no	no	no	no
RRT Path Smoothing	no	no	no	no
RRT	no	no	no	no
DFS	no	no	no	no

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RESULTS. CORRELATIONS

TABLE III

TYPE OF CORRELATION AMONG (CLEARANCE, PATH_LENGTH, ITERATION) AND (# OBSTACLES, PATH_LENGTH, ITERATION). SIGN - IS NEGATIVE, + IS POSITIVE AND X NO CORRELATION

	Clearance		# Obstacles	
Algorithm	**Path Length**	**Iteration**	**Path Length**	**Iteration**
Visibility Road Map	-	x	-	+
A*	-	+	-	x
Dijkstra	-	+	-	+
BFS	-	+	-	+
Bidir BFS	-	+	-	+
Bidir A*	-	+	x	x
RRT*	-	-	x	x
Greedy Best First Search	-	-	-	-
RRT Sobol Sampler	-	-	x	x
RRT Path Smoothing	-	-	x	x
RRT	-	-	x	x
DFS	-	-	-	-

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CONCLUSION & FUTURE WORK

- It was posible to establish relationships between the metrics, the algorithms, and the restrictions

- These results are shown qualitatively and were obtained using data analysis tools

- Future work, we intend to develop statistically validated indices that allow a quantitative approach and allow to generalize a prediction model of the behavior of the algorithms under different types of constraints