

Traditional landmine: pressure triggered



Primitive landmine in the 14th century



Explosive mechanical landmine

Sensor enabled smart-mine: sound, vibration, magnetism, wireless.



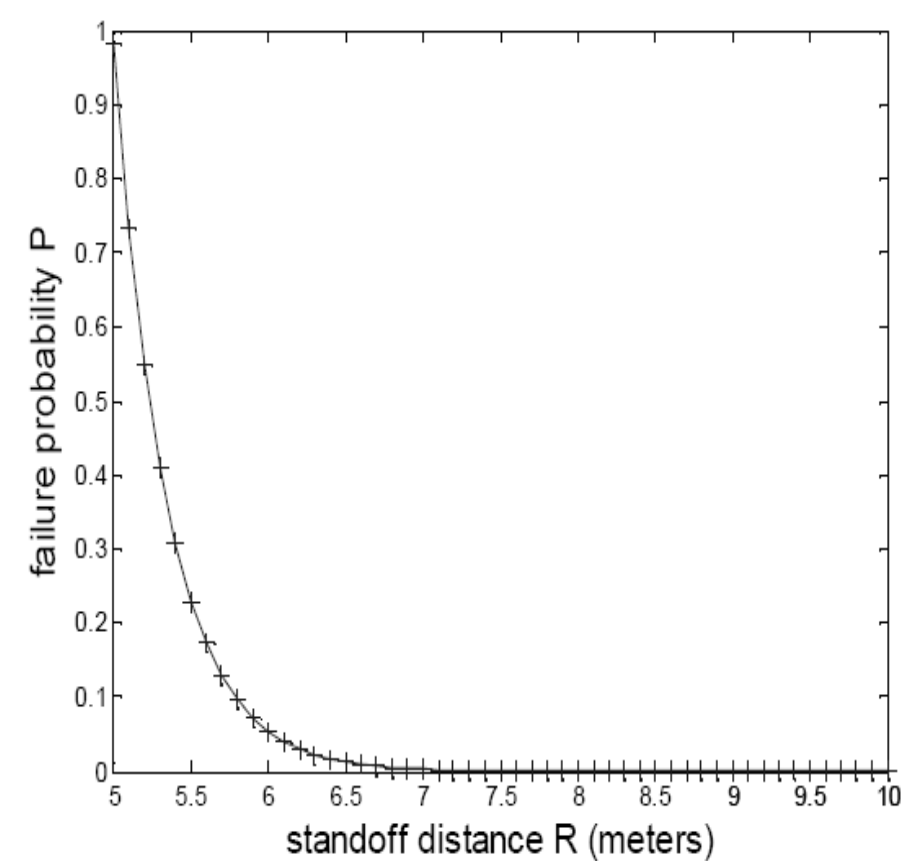
Sensors bring new opportunities: sensing capability, wireless communication, collaborative decision making

Motivation

Fill the gap between the mine industry and impact engineering.

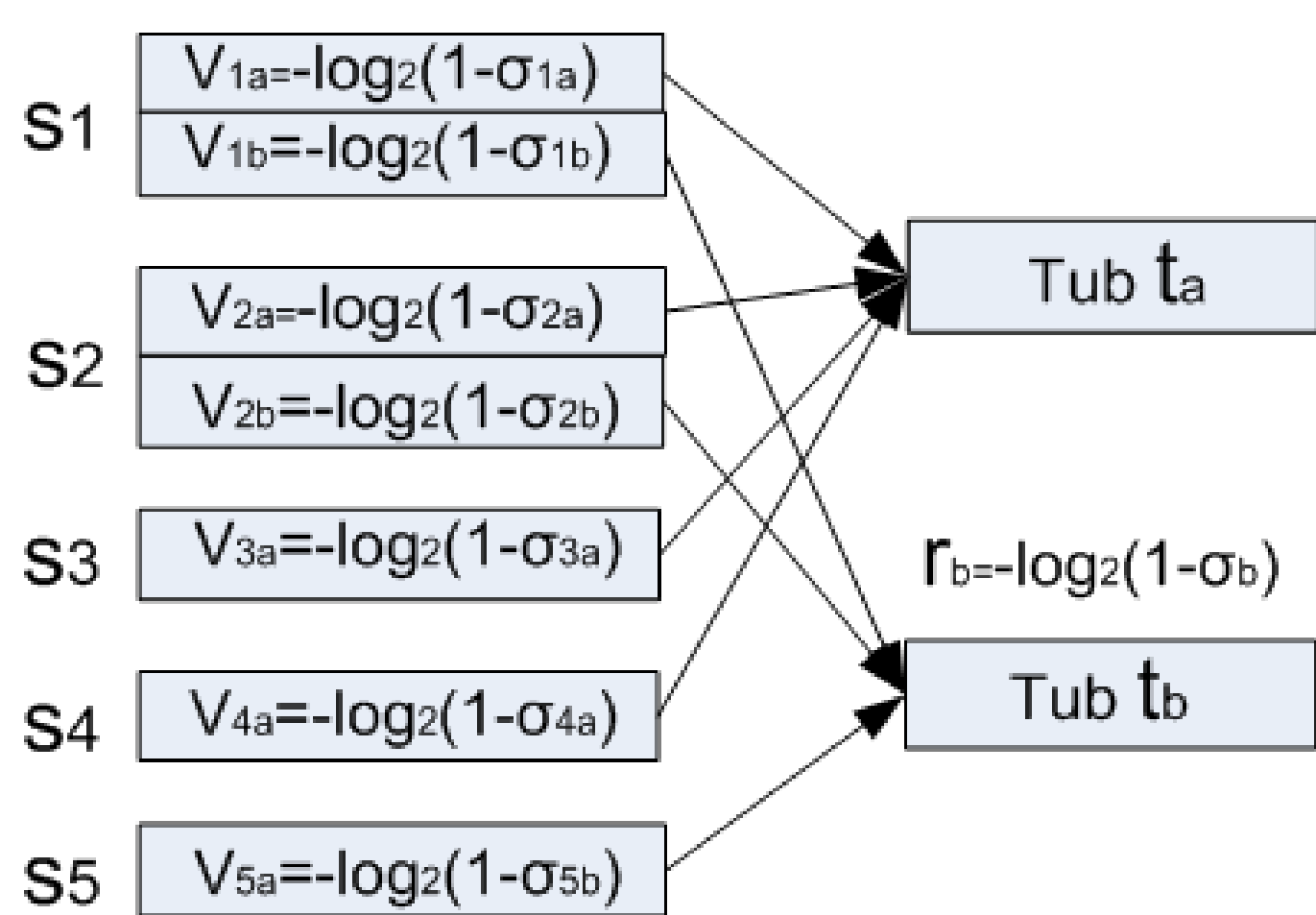
$$P = \frac{e^{\left[-5.785 \times \left(\frac{R}{Q^{1/3}}\right) + 19.047\right]}}{100}$$

ESTC outdoor blast model:
how standoff distance can affect the destructive effect



Algorithms

The original graph is transformed into a **bucket-tub model**: each mine is modeled by a bucket set and each target is modeled by a tub.



Greedy algorithm: select the mine with the least average cost in each round

Layering algorithm: decompose the bucket-tub graph into layers

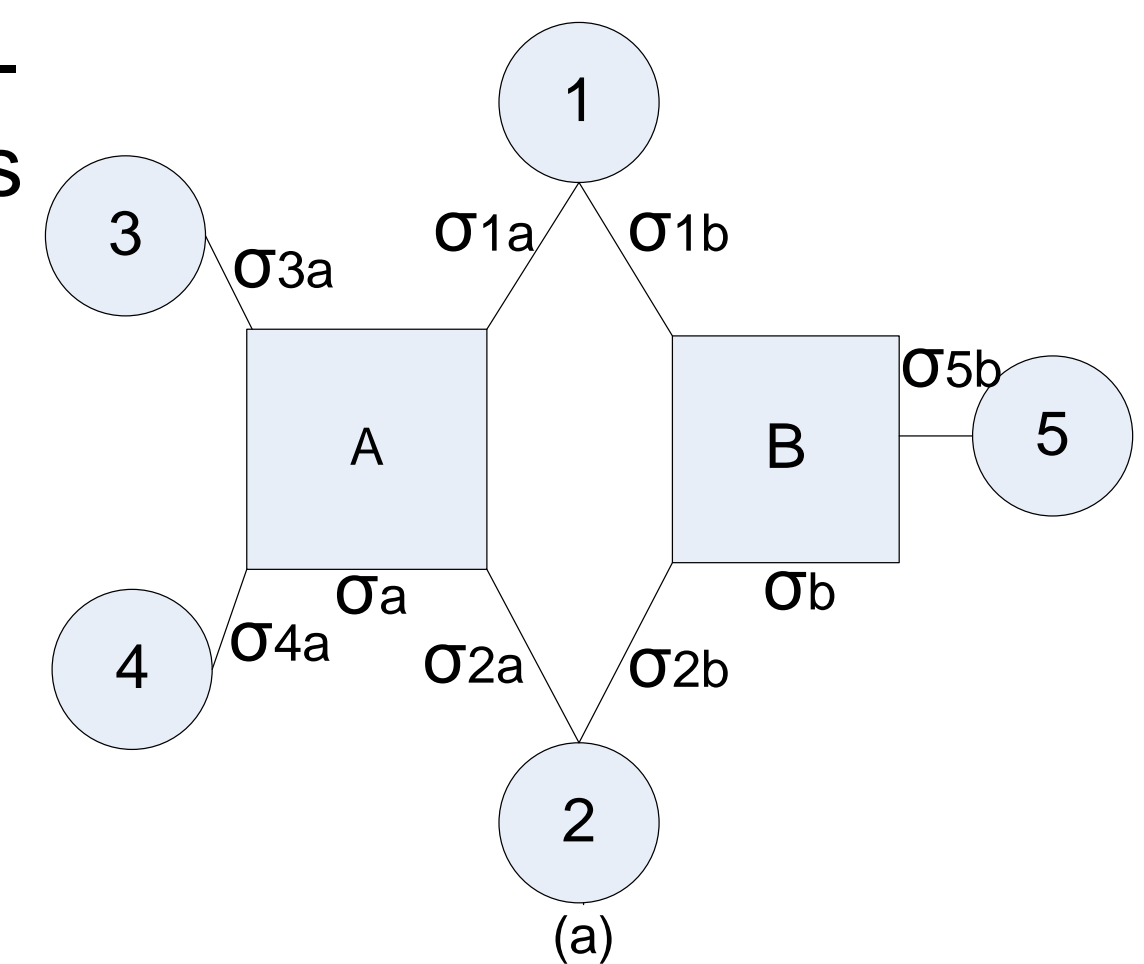
Problem Formulation

A defense scenario with m intruders and n smart-mines.

Objective: select the minimum-cost mines to destroy all targets with a predefined probability

Assumption:

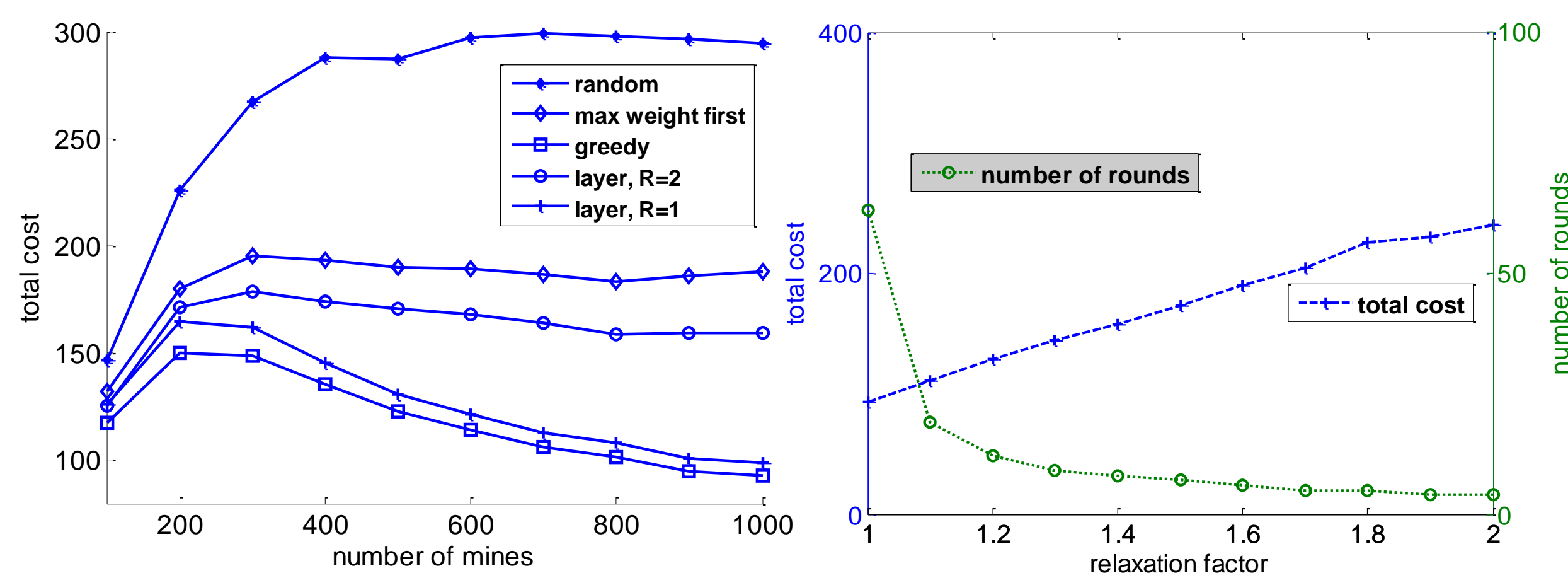
- 1) The distance between the mine and target is known
- 2) ESTC outdoor blast model is used



Performance

Theorem: the layering algorithm has an approximation ratio of $\alpha \cdot f$, where f is the maximum number of bucket sets associated with a target, and α is the relaxation factor

Distributed implementation: the same solution set is produced as in the global version of the greedy algorithm.



Publication

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