Flashbang Optimisation Problem

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1 Introduction

Suppose there are n terrorists in a space in the $2d$ box $[0,1]^2$, labelled (x_k, y_k) for $k = 1 \dots n$. What position (x, y) should you throw a flashbang to blind them all as much as possible? The light drops off with the inverse square law, $1/r^2$ where r is the distance between the terrorist and the flashbang. We wish to maximise the objective function for $r_k = \sqrt{(x - x_k)^2 + (y - y_k)^2}$

$$h(x, y) = \alpha \sum_{k=1}^{n} \frac{1}{r_k^2} \tag{1.1}$$

where α is a parameter to be varied for dimensions. We add the constraint that if the light is placed within β of the terrorist then h returns 0. Without this, simply placing the light directly inside of a terrorist is possible, which will return an infinite value.

An alternative to this is to use the objective function

$$g(x, y) = \alpha \frac{a^2 e^2}{4} \sum_{k=1}^{n} \frac{\exp(-a/x)}{r_k^2} \tag{1.2}$$

with a parameter $a > 0$ that determines the strength of the falloff near the terrorist.

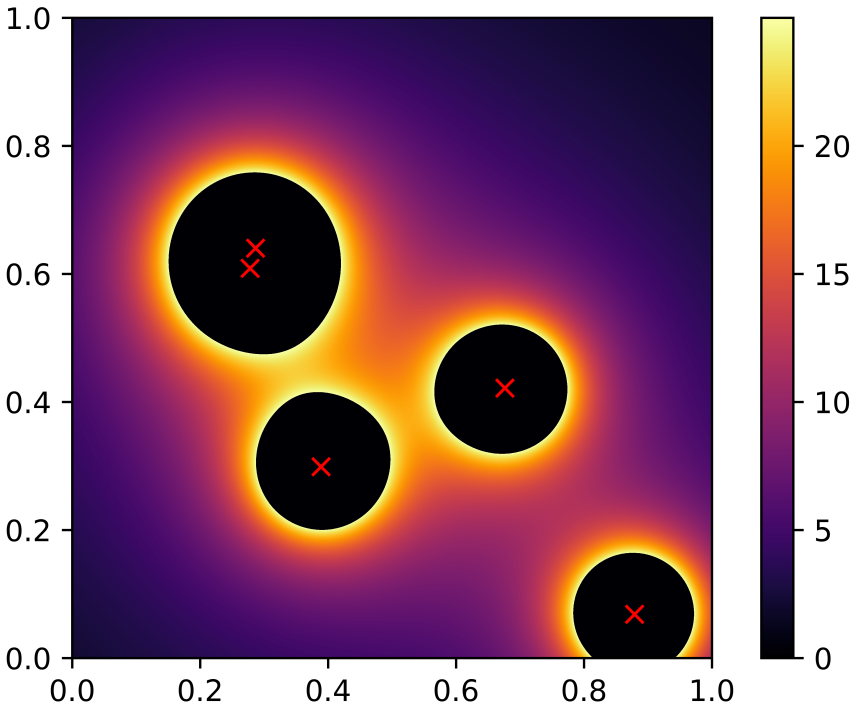

Figure 1. Example with 5 terrorists, and $\beta = 0.2 = \alpha$.