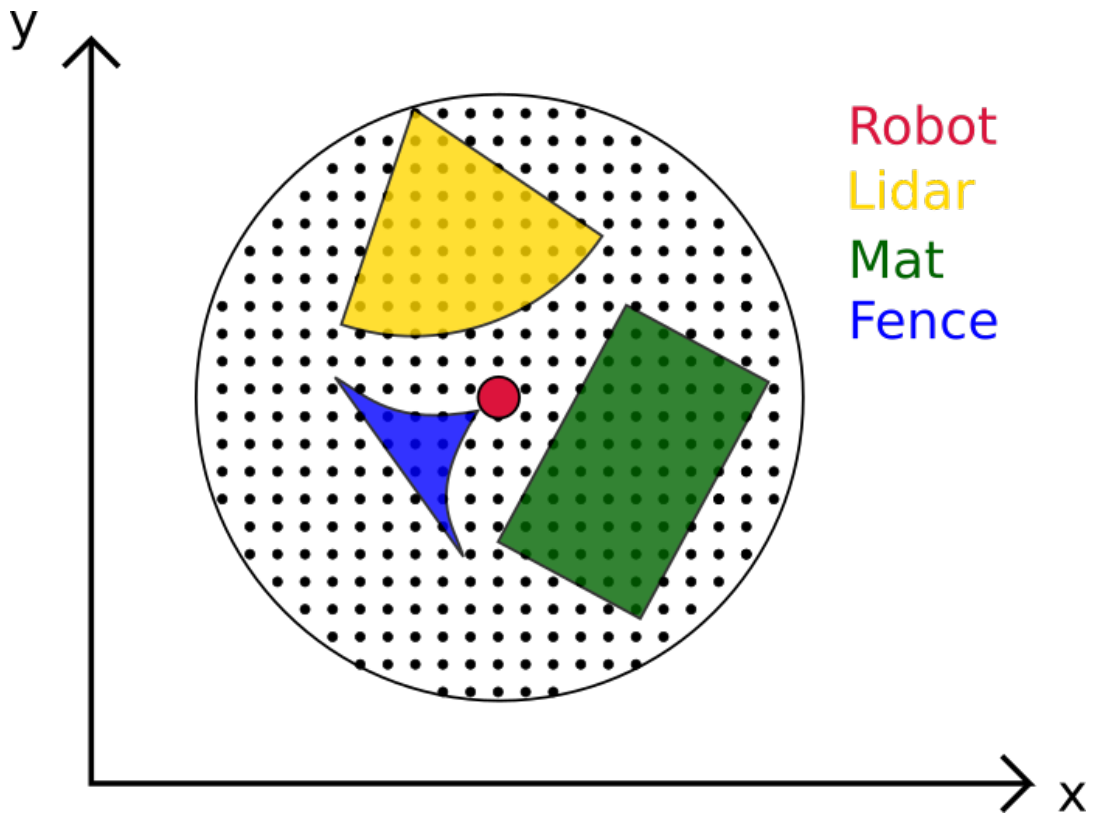
Optimization of cost function

thoughts

- define coverage problem (with individual geometric properties of each sensor type)
- discrete problem by using grid-based model
- safety is measured by number of sensors covering grid point (constraint: ≥ 1)



Constraints:

- lidar:
  $CM_{lid} \in (R,s_{lid})$
- mat:
  $(A,B) \perp (R,CM_{mat})$
- fence:
  $(A,B) \perp (R,CM_{fence})$

better: polar coordinates with radius *r* and angle φ

parameters

(x,y)	tuple of coordinates (e.g. grid point)
s_{lid}	tuple of lidar positions (consisting out of coordinates (x,y))
s_{mat}	tuple of mat positions
s_{fence}	tuple of fence positions
n_i	number of sensors of type i (= $len(s_i)$)
R_i	radius of sensor type i
$f(x,y,s)$	local safety function
$F(s)$	global safety function
$C(s)$	cost function

functions

- sensor positions: $s_{lid}, s_{mat}, s_{fence}$
- local safety function: $f(x, y, s_{lid}, s_{mat}, s_{fence}) = \langle \begin{matrix} 0 \\ 1 \end{matrix}$
- global safety fct.: $F(s_{lid}, s_{mat}, s_{fence}) = \sum_{x,y} f(x, y, s_{lid}, s_{mat}, s_{fence})$
- cost function: $C(s_{lid}, s_{mat}, s_{fence}) = \sum_{i} c_i \cdot len(s_i)$

possible algorithm: stimulated annealing[1]

if area_sensors < area:
    n_i ++
else:
    place sensors randomly: tuples s_1, s_2 and s_3
    for x in range(s_i[:][0]):
        for y in range(s_i[0][:]):
            f(x,y) = number of sensors covering grid point
            if f(x,y) == 0:
                count ++
                if count > (15…) : stop loop
            F += f(x,y)
        if F > F_{max}:
            F_{max} = F
        else:
            F_{max} = F with probability exp($\frac{F_{max} - F}{T}$)

1) https://de.wikipedia.org/wiki/Simulated_Annealing

problems

- variable size of sensor range → how to optimize?
  - constant size of sensors
- different types of sensors make algorithm very complicated, how to count?
  - geometrical problem + optimization of cost function (used sensor area vs. covered area; cost of each sensor; latency (only lidar?))
- sensor placement in simulated annealing process → random?
  - yes (maybe even distribution as addition)