Task 3: Localization under sparse sensor attacks

```
%-----------------------------------------------------
%  Project "Modeling and Control of CPS"
%           TASK 3 - Localization under sparse attacks
%
%                         Latest Update: 21.04.2024
%
%-----------------------------------------------------
clear
close all
clc
```

Data loading

This time we use real data, in particular we have:

- The dictionary $D \in \mathbb{R}^{100,25}$ in which we can find the RSS-fingerprinting
- The vector $y \in \mathbb{R}^{25}$ of the measuremtents

```
%load the provided data D, y
load localization.mat
```

Hyperparameter setting

```
%   hyperparameters
p=100;                                   %number of cells of the grid
q=25;                                    %number of sensors
count=0;

delta=1e-15;                             %used in the stop
condition

tol=0.1;                                 %are really non-zero components?

lambda1=10;   lambda2=20;               %weights of the lasso
eps=1e-8;
lambda=[lambda1*ones(p,1); lambda2*ones(q,1)];  %sparse
G=[D eye(q)];                                   %augmented sensing matrix
G=normalize(G);
tau= (norm(G)^(-2))-eps;                        %step size

z_calc=zeros((p+q), 1);   %z_0
%----------------------------------------------------------
```

ISTA implementation for localization purposes

```
%-------------ISTA for localization------------------------
while 1
```

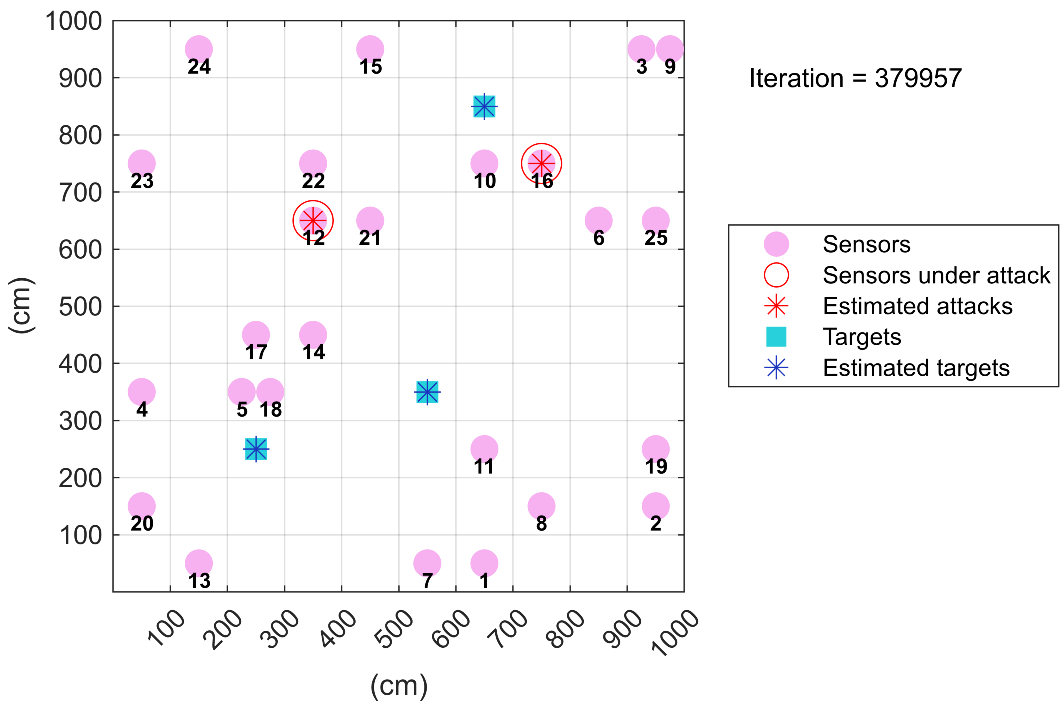
```
    z_prev=z_calc;
    %.........passo k+1 dell'algoritmo
    qi=z_prev+tau*G'*(y-G*z_prev);
    %For each component, apply the S.T. operator
    for j=1:1:(p+q)
        %nuovo elemento di x
        z_calc(j,1) = sto(qi(j), lambda(j)*tau);
    end
    %.....................................................
    if(norm(z_calc-z_prev)<delta)
        break
    end
    count=count+1;
end
```

Data cleaning

```
tol=4;
for i=1:(p+q)
    if(abs(z_calc(i))<tol)
        z_calc(i)=0;
    end
end

%Separate x and a
x_calc = z_calc(1:p);
a_calc = z_calc(p+1:end);
Supp_x = find(x_calc)';
Supp_a = find(a_calc)';
```

ISTA: Graphical representation of the room

```
room(Supp_x,Supp_a,"ISTA",count)
```



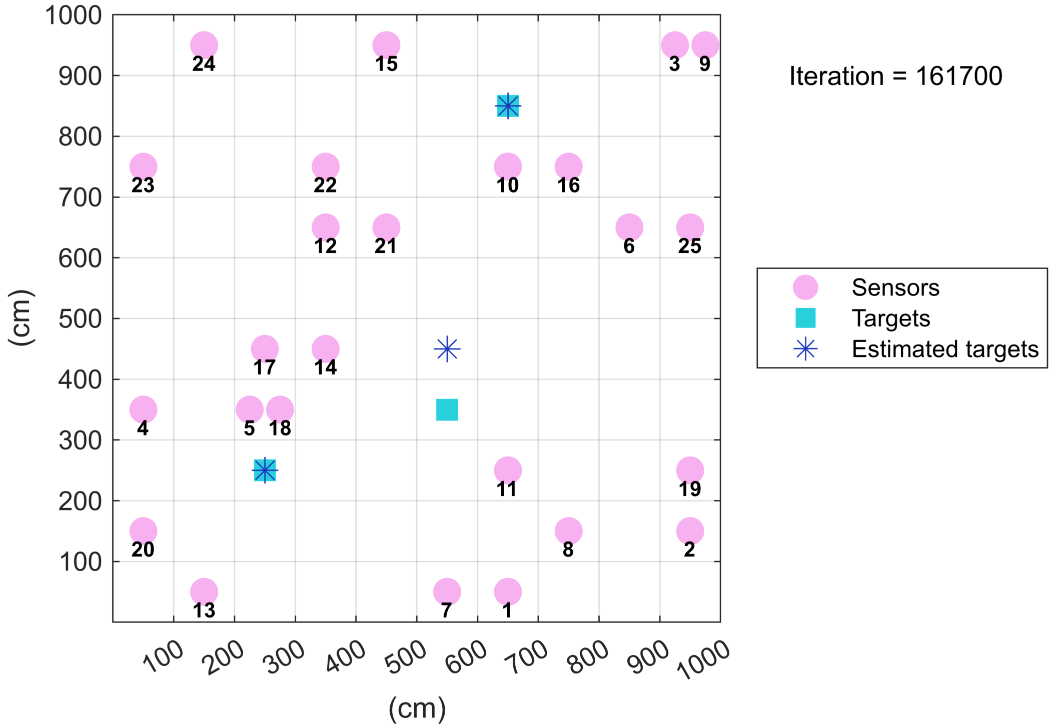
```
count=0;
```

Alternative technique to Localization (attack free): K-Nearest Neighbours

```
%% Alternative to Localization: k-NN (attack free)
min = 10000;

for d1=1:p
    for d2=1:p
        if d2>=d1
            break
        end
        for d3=1:p
            if d3>=d2
                break
            end
            %if d2>d1 && d3>d2

            diff = norm(D(:,d1)+D(:, d2)+D(:,d3)-y)^2;

            if diff < min
                x1 = d1;
                x2 = d2;
                x3 = d3;
                min = diff;
            end
            count=count+1;
            %end
        end
    end
end
supp_x_knn(1) = x1;
supp_x_knn(2) = x2;
supp_x_knn(3) = x3;
```

K-NN: graphical representation of the room

```
room(supp_x_knn,0,"K-NN",count)
```


Iteration = 161700
Sensors
Targets
Estimated targets
(cm)
(cm)