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final project mass properties solver

```
clear all
close all
clc
```

single cube

```
% detumble
detumble.m = 640; % mass in kg
detumble.dim = [2;2;2]; % x y and z lengths
detumble.CM = [0;0;0]; % x y and z locations of CM
detumble.name = "Detumble";
detumble.moi = moi(detumble);
```

individual parts

```
% bus
piece1.m = 500; % mass in kg
piece1.dim = [2;2;2]; % x y and z lengths
piece1.CM = [0;0;0]; % x y and z locations of CM
piece1.name = "Bus";

% sensor
piece2.m = 100; % mass in kg
piece2.dim = [.25;.25;1]; % x y and z lengths
piece2.CM = [0;0;1.5]; % x y and z locations of CM
piece2.name = "Sensor";

% panels
piece3.m = 20; % mass in kg
piece3.dim = [2;3;.05]; % x y and z lengths
piece3.CM = [0;2.5;0]; % x y and z locations of CM
piece3.name = "Panel1";

piece4 = piece3;
piece4.m = 20; % mass in kg
piece4.dim = [2;3;.05]; % x y and z lengths
piece4.CM = [0;-2.5;0]; % x y and z locations of CM
```

```
piece4.name = "Panel2";


pieces = [piece1,piece2,piece3,piece4];
clear piece1 piece2 piece3 piece4
```

do calcs

```
% moi pieces
for i = 1:length(pieces)
    pieces(i).moi = moi(pieces(i));
end

% CM nominal
nominal.m = sum([pieces.m]);
nominal.CM = sum([pieces.m].*[pieces.CM]./nominal.m,2);
nominal.name = "Nominal";
```

moi nominal - parallel axis

```
% distance from total CM to peice CM
for i = 1:length(pieces)
    r = nominal.CM - pieces(i).CM;

    x = r; % r is location of the peice CM in BOD
    x(1) = 0; % perpendicular location from x axis
    x = norm(x); % perpependicular distance from x axis

    y = r;
    y(2) = 0;
    y = norm(y);

    z = r;
    z(3) = 0;
    z = norm(z);

    pieces(i).r = [x;y;z]; % set of perpendicular distances from their
 respective axes

end

nominal.moi = sum([pieces.moi],2)+sum([pieces.m].*[pieces.r].^2,2);
```

fix Coords about CM of SC instead of geometric center of Bus

```
for i = 1:length(pieces)
    pieces(i).CM = pieces(i).CM - nominal.CM;
end

nominal.CM = nominal.CM-nominal.CM;
```

output

```
disp("The mass properties of the S/C in detumble operation are as follows: ")
disp("Mass in kg: "+string(detumble.m))
disp("The location of the ceter of mass in m in the body referenece frame in
 m: ")
disp(detumble.CM)
disp("Ix: "+string(detumble.moi(1)))
disp("Iy: "+string(detumble.moi(2)))
disp("Iz: "+string(detumble.moi(3)))

disp(" ")
disp(" ")

disp("The mass properties of the S/C in nominal operation are as follows: ")
disp("Mass in kg: "+string(nominal.m))
disp("The location of the ceter of mass in m in the body referenece frame in
 m: ")
disp(nominal.CM)
disp("The location of the geometric center of the bus in the body referenece
 frame in m: ")
disp(pieces(1).CM)
disp("Ix: "+string(nominal.moi(1)))
disp("Iy: "+string(nominal.moi(2)))
disp("Iz: "+string(nominal.moi(3)))
```

```
The mass properties of the S/C in detumble operation are as follows:
Mass in kg: 640
The location of the ceter of mass in m in the body referenece frame in m:
     0
     0
     0

Ix: 426.6667
Iy: 426.6667
Iz: 426.6667


The mass properties of the S/C in nominal operation are as follows:
Mass in kg: 640
The location of the ceter of mass in m in the body referenece frame in m:
     0
     0
     0

The location of the geometric center of the bus in the body referenece frame
 in m:
         0
         0
   -0.2344

Ix: 812.0396
Iy: 545.3729
```

Iz: 627.7083

functions

```
function out = moi(piece)
out(1) = (1/12)*piece.m*(piece.dim(2)^2+piece.dim(3)^2);
out(2) = (1/12)*piece.m*(piece.dim(1)^2+piece.dim(3)^2);
out(3) = (1/12)*piece.m*(piece.dim(1)^2+piece.dim(2)^2);
out = out';
end
```

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