QEA 2 Robo Homework 6

By Ari Porad, April 25th, 2021

Exercise 27.1

27.1.2

```
p = [2 -1]
```

```
p = 1×2
     2    -1
```

```
theta = pi / 3;
R = [cos(theta), sin(theta); -sin(theta), cos(theta)]
```

```
R = 2×2
    0.5000    0.8660
   -0.8660    0.5000
```

```
R * p'
```

```
ans = 2×1
    0.1340
   -2.2321
```

```
inv(R) * [3;-2]
```

```
ans = 2×1
    3.2321
    1.5981
```

```

```

27.2

```
r1g = [2 -1 1]'
```

```
r1g = 3×1
     2
    -1
     1
```

```
theta = pi / 3;
R = [cos(theta), sin(theta), 0; -sin(theta), cos(theta), 0; 0, 0, 1]
```

```
R = 3×3
    0.5000    0.8660         0
   -0.8660    0.5000         0
         0         0    1.0000
```

```
T = [1, 0, 3; 0, 1, -1; 0, 0, 1]
```

```
T = 3×3
```

```
     1     0     3
     0     1    -1
     0     0     1
```

```
r1m = R * T * r1g
```

```
r1m = 3×1
    0.7679
   -5.3301
    1.0000
```

```
r2m = [3 -2 1]'
```

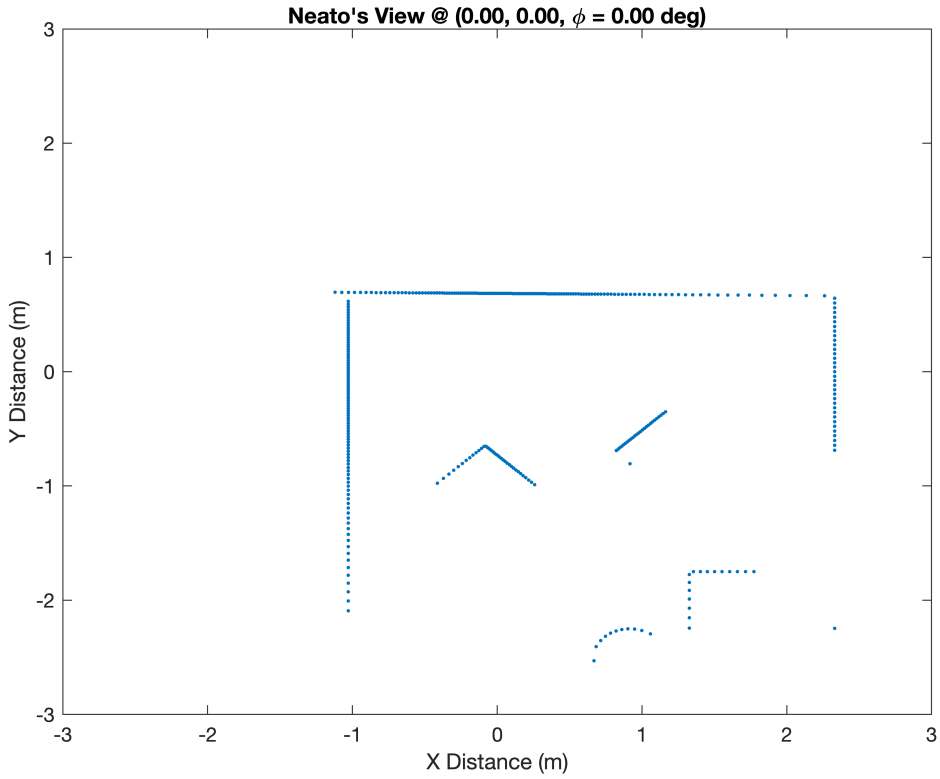
```
r2m = 3×1
     3
    -2
     1
```

```
r2g = inv(T) * inv(R) * r2m
```

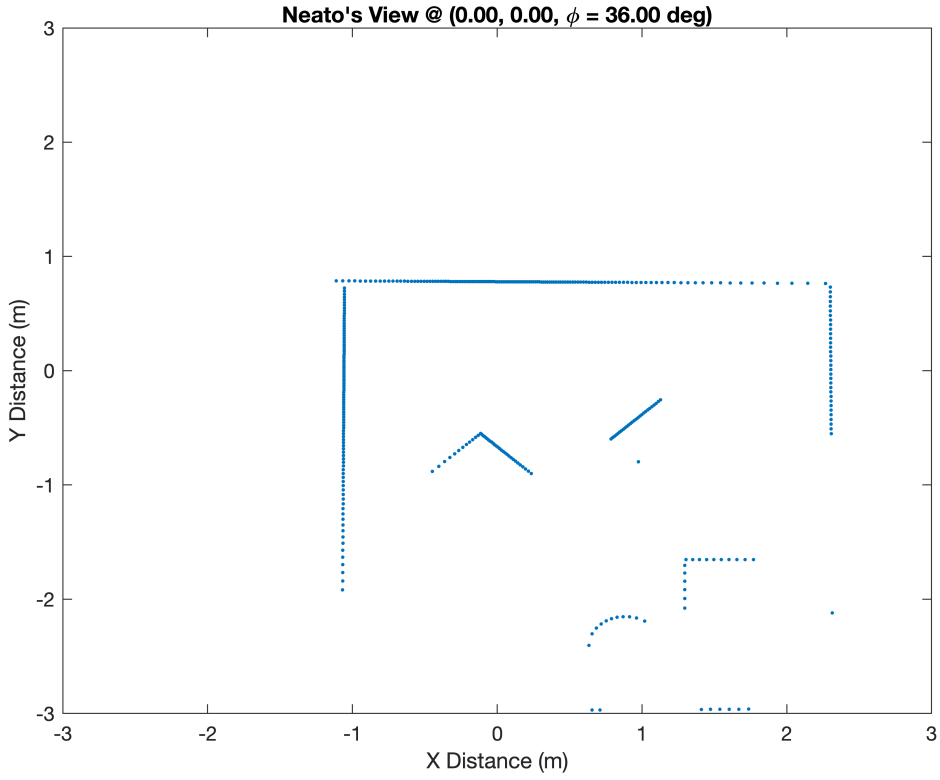
```
r2g = 3×1
    0.2321
    2.5981
    1.0000
ans = 1×3
    0.2321    2.5981    1.0000
```

Exercise 27.4

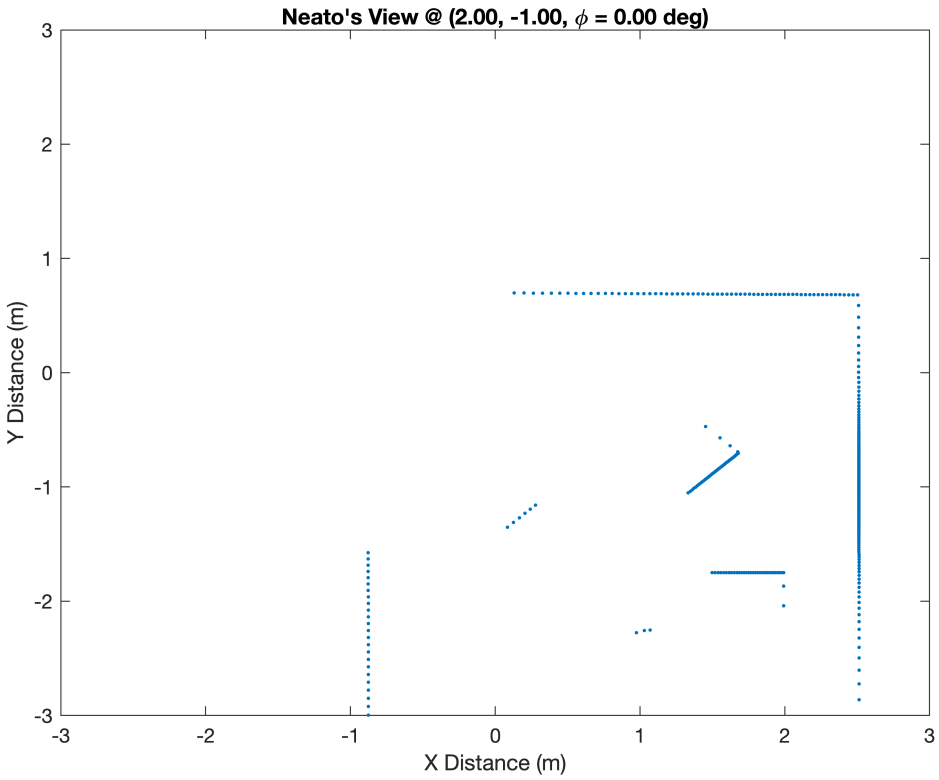
```
load('lidar.mat', 'theta_all', 'r_all');

r1g = plot_helper(r_all(:, 1), theta_all(:, 1), [0, 0], 0);
```



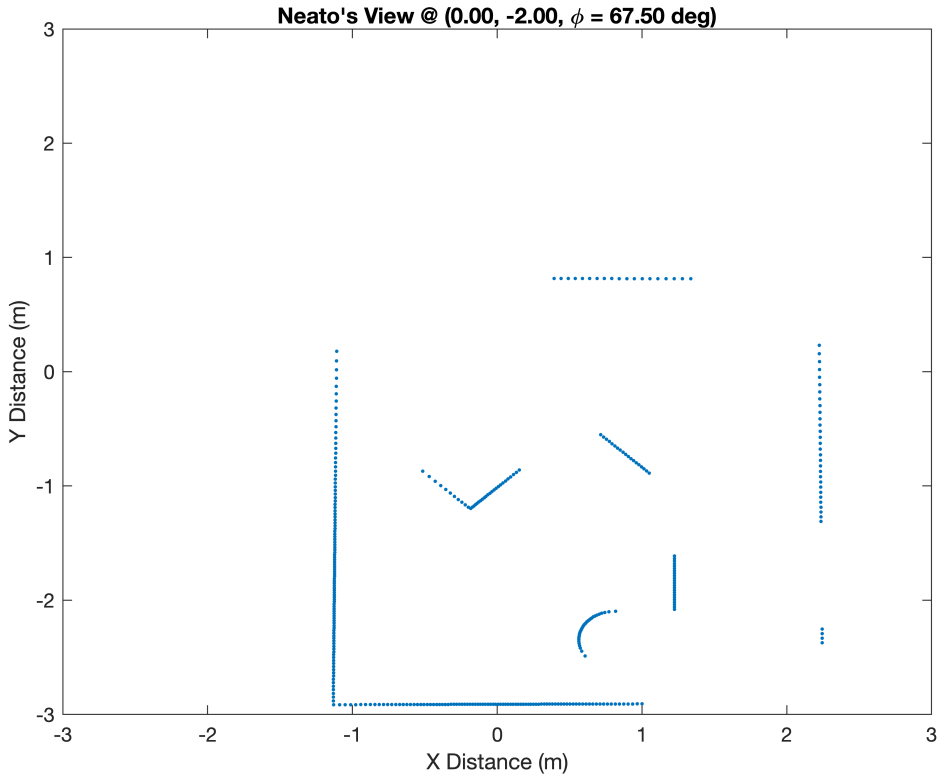

```
r2g = plot_helper(r_all(:, 2), theta_all(:, 2), [0, 0], pi/5);
```



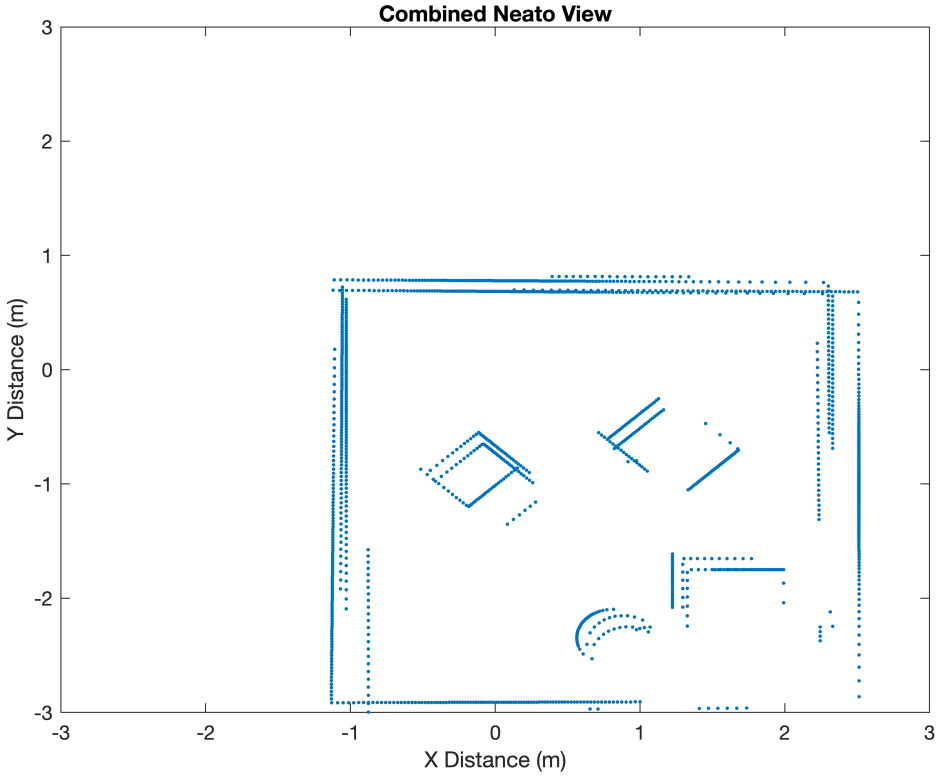
```
r3g = plot_helper(r_all(:, 3), theta_all(:, 3), [2, -1], 0);
```




```
r4g = plot_helper(r_all(:, 4), theta_all(:, 4), [0, -2], (3*pi) / 8);
```




```
rallg = [r1g; r2g; r3g; r4g];

figure;
plot(rallg(:, 1), rallg(:, 2), '.');
title("Combined Neato View");
xlabel("X Distance (m)");
ylabel("Y Distance (m)");
ylim([-3, 3]);
xlim([-3, 3]);
```




```
function r_G = to_global(R, theta, origin, phi)
    [X_raw, Y_raw] = pol2cart(theta, R);
    r_L = [X_raw, Y_raw, ones(length(X_raw), 1)]';
    r_N = [1, 0, 0.084; 0, 1, 0; 0, 0, 1] * r_L; % no rotation needed
    r_G_raw = [1, 0, origin(1); 0, 1, origin(2); 0, 0, 1] * [cos(phi), -sin(phi), 0; s
    r_G = r_G_raw(1:2, :)';
end

function r_G = plot_helper(R, theta, origin, phi, desc)
    if nargin < 5
        desc = "Neato's View";
    end

    r_G = to_global(R, theta, origin, phi);

    figure;
    plot(r_G(:, 1), r_G(:, 2), '.');
    title(sprintf("%s @ (%1.2f, %1.2f, \\phi = %1.2f deg)", ...
        desc, origin(1), origin(2), rad2deg(phi)));
    xlabel("X Distance (m)");
    ylabel("Y Distance (m)");
    ylim([-3, 3]);
    xlim([-3, 3]);
end
```