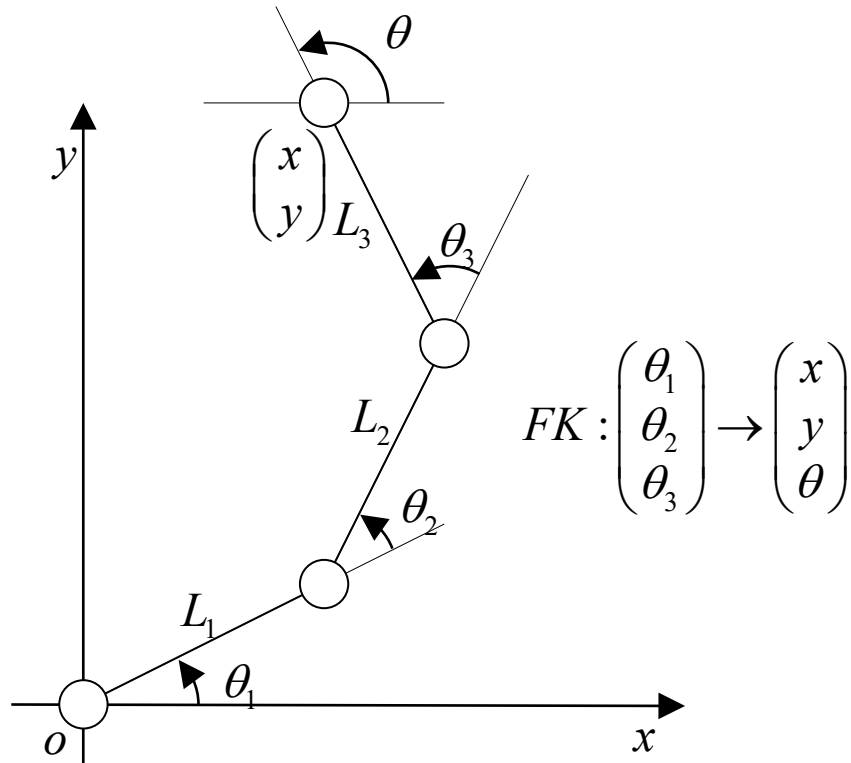


ロボットアームの順運動学: Matlabによるコーディング

Robot Arm Forward Kinematics: Matlab Coding

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まとめ

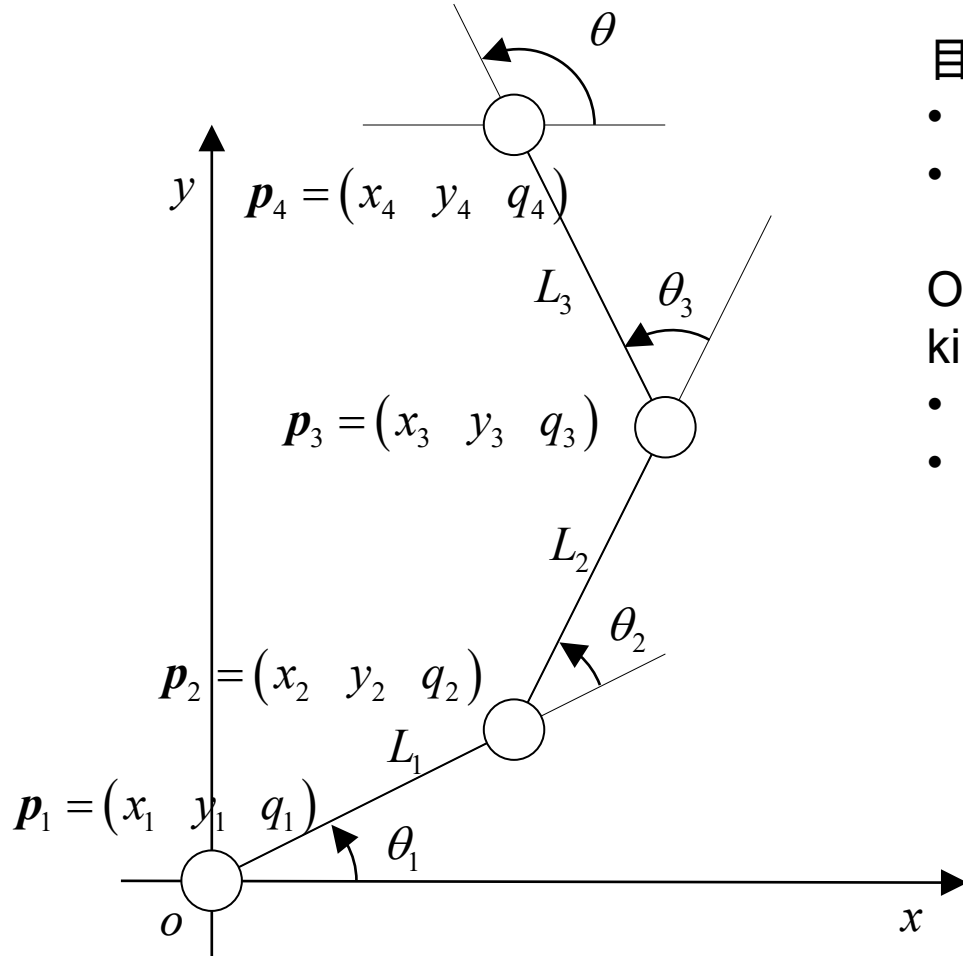
- Matlabによる順運動学関数のコーディング

Summary

- Matlab coding of a forward kinematics function

ロボットアームの順運動学関数のMatlab コーディング

Matlab Coding of Forward Kinematics Function of Robot Arm



目的: ロボットアームの順運動学をMatlabの関数として実装する

- 引数: 関節角度ベクトル
- 戻り値: 姿勢行列 (行が各関節の姿勢を表す)

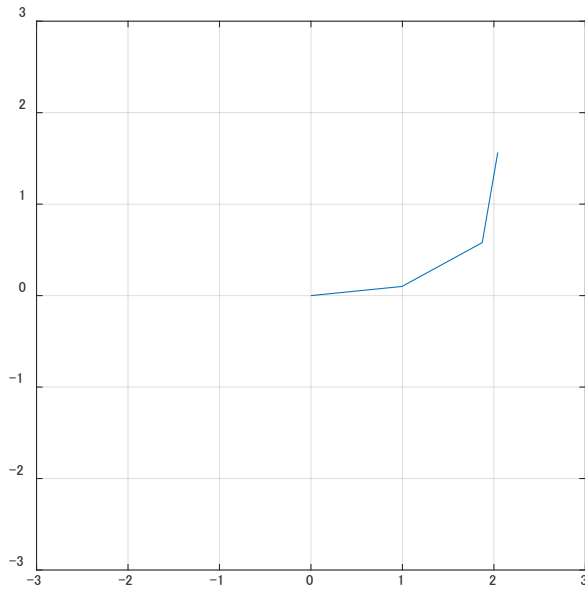
Objective: To implement a matlab function to solve forward kinematics of a robot arm

- Argument: A joint angle vector
- Return: A pose matrix, in which a row represents a pose of each of the joints

$$\mathbf{q} = (q_1, q_2, q_3) \xrightarrow{\mathbf{p} = \text{fk}(\mathbf{q})} \mathbf{p} = \begin{pmatrix} \mathbf{p}_1 \\ \mathbf{p}_2 \\ \mathbf{p}_3 \\ \mathbf{p}_4 \end{pmatrix} = \begin{pmatrix} x_1 & y_1 & q_1 \\ x_2 & y_2 & q_2 \\ x_3 & y_3 & q_3 \\ x_4 & y_4 & q_4 \end{pmatrix}$$

Matlabによる順運動学関数の実装：呼び出しとプロット

Matlab Implementation of Forward Kinematics Function: Call and Plot



```
% Joint angles
q = [0.1, 0.4, 0.9];

% Forward kinematics calculation
p = fk(q);

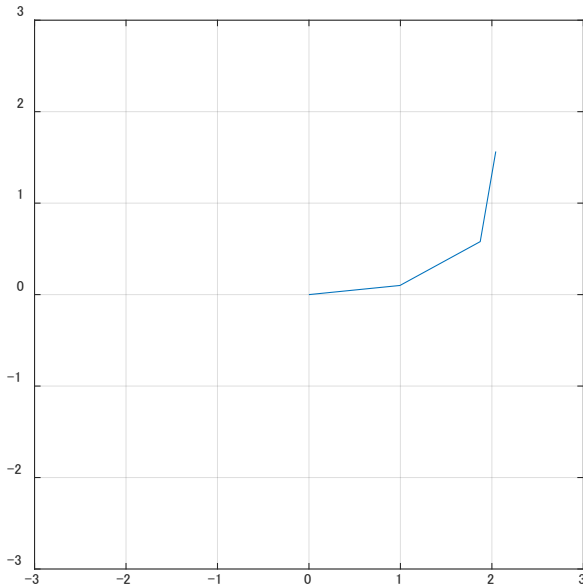
% Plot poses
% Open a new plot window named Figure 1
figure(1);
% p(:,1): A vector of X positions
% p(:,2): A vector of Y positions
plot(p(:,1), p(:,2));
% Set plot range
xlim([-3, 3]); ylim([-3, 3]);
% Set aspect ratio between x, y, and z
paspect([1, 1, 1]);
% Set grid on plot
grid on;
```

$$\mathbf{q} = (q_1, q_2, q_3) \xrightarrow{\mathbf{p} = \text{fk}(\mathbf{q})} \mathbf{p} = \begin{pmatrix} p_1 \\ p_2 \\ p_3 \\ p_4 \end{pmatrix} = \begin{pmatrix} x_1 & y_1 & q_1 \\ x_2 & y_2 & q_2 \\ x_3 & y_3 & q_3 \\ x_4 & y_4 & q_4 \end{pmatrix}$$

Code is available at https://github.com/keitaronaruse/Naruse-robotics-tutorial/blob/main/src/matlab/fk_3Link_Planar.m

Matlabによる順運動学関数の実装

Matlab Implementation of Forward Kinematics Function



```
function p = fk(q)
% Robot arm parameters
L1 = 1.0; L2 = 1.0; L3 = 1.0;

% Pose calculation
% pi = [xi, yi, qi]
p1 = [0,0,0];
p2 = p1 + [L1 * cos(q(1)), L1* sin(q(1)), q(1)];
p3 = p2 + [L2 * cos(q(1)+q(2)), L2* sin(q(1)+q(2)), q(2)];
p4 = p3 + [L3 * cos(q(1)+q(2)+q(3)), L3* sin(q(1)+q(2)+q(3)), q(3)];

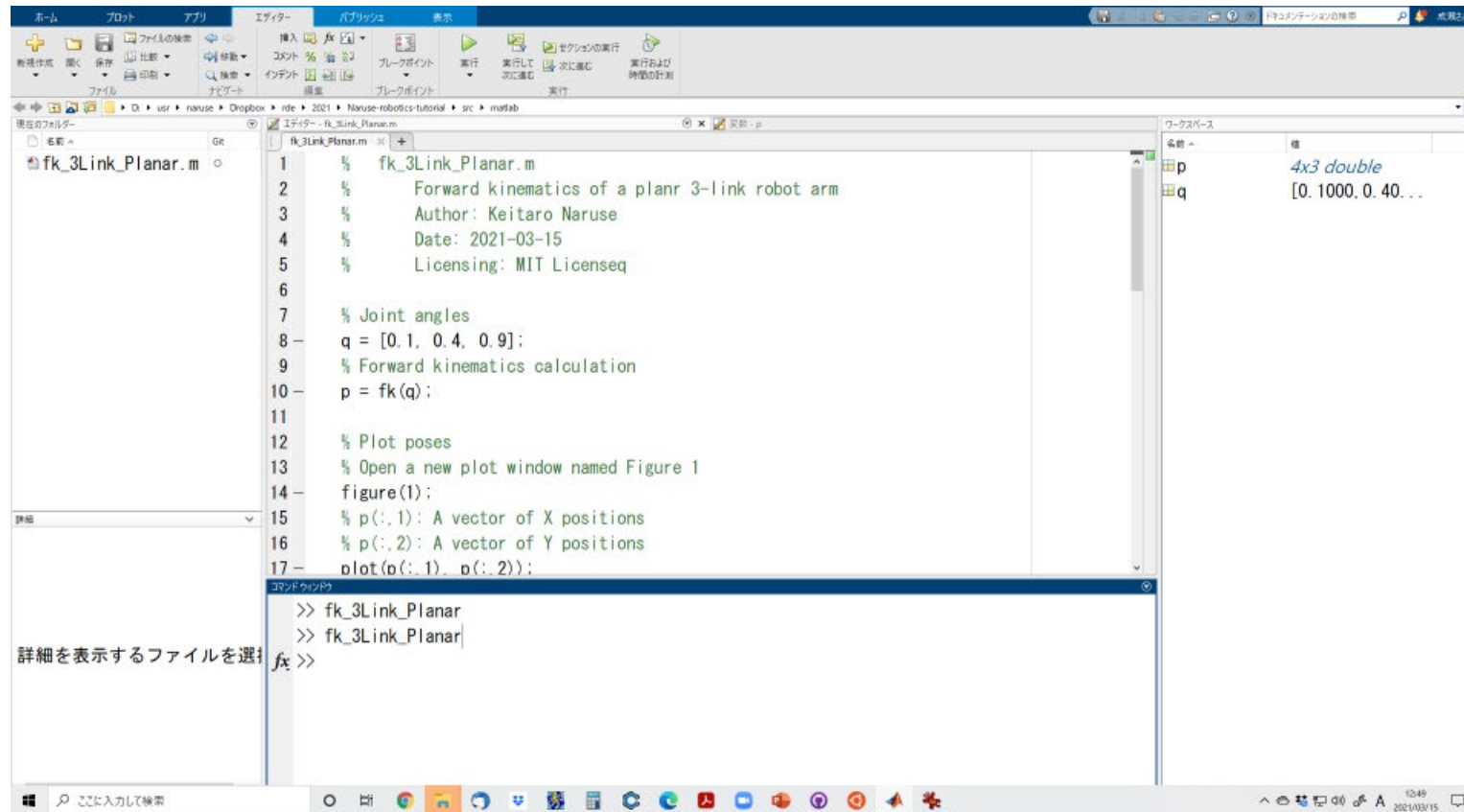
% Set the four poses in a pose vector p
p = [p1; p2; p3; p4];
end
```

$$\mathbf{q} = (q_1, q_2, q_3) \xrightarrow[p = \text{fk}(\mathbf{q})]{\text{red arrow}} \mathbf{p} = \begin{pmatrix} p_1 \\ p_2 \\ p_3 \\ p_4 \end{pmatrix} = \begin{pmatrix} x_1 & y_1 & q_1 \\ x_2 & y_2 & q_2 \\ x_3 & y_3 & q_3 \\ x_4 & y_4 & q_4 \end{pmatrix}$$

Code is available at https://github.com/keitaronaruse/Naruse-robotics-tutorial/blob/main/src/matlab/fk_3Link_Planar.m

Matlabの順運動学コードのデモンストレーション

Demonstration of Matlab Forward Kinematics Code



```
1 % fk_3Link_Planar.m
2 % Forward kinematics of a planr 3-link robot arm
3 % Author: Keitaro Naruse
4 % Date: 2021-03-15
5 % Licensing: MIT License
6
7 % Joint angles
8 q = [0.1, 0.4, 0.9];
9 % Forward kinematics calculation
10 p = fk(q);
11
12 % Plot poses
13 % Open a new plot window named Figure 1
14 figure(1);
15 % p(:,1): A vector of X positions
16 % p(:,2): A vector of Y positions
17 plot(p(:,1), p(:,2));
```

Workspace:

変数	値
p	4x3 double
q	[0.1000, 0.40...

コマンドウィンドウ:

```
>> fk_3Link_Planar
>> fk_3Link_Planar
fx >>
```