```
clear, clc
tic
syms px py pz az ax ay
syms q1 q2 q3

L1 = 13.5
L2 = 15
L3 = 20

DHParam = [q1 L1 0 pi/2; (pi/2+q2) 0 L2 0; q3 0 L3 0];

[A, T, Q, Rot, Tra] = DH(DHParam, px, py, pz, az);

%assume(q1>-pi & q1<pi & q2>-pi & q2<pi & q3>-pi & q3<pi)
assume(pz>0 & q1<0 & q1 > -pi)% & q2>0 & q3>0)

    EqX = px == simplify(Tra(1));
    EqY = py == simplify(Tra(2));
    EqZ = pz == simplify(Tra(3));

    jointVar = symvar(T);


    %%%%%%%%%55

% A es el arreglo conteniendo las matrices de transformación de i = 1 a i =
% n. T es la matriz de transformación simplificada, la matriz de cinemática
% directa. Q es un vector conteniendo los resultados para las variables de
% q1 a qn. Rot es la matriz de rotación extraída de T. Y Tra es el ventor
% posición extraído de T.

% syms n_x s_x a_x p_x n_y s_y a_y p_y n_z s_z a_z p_z
% T_syms = [n_x s_x a_x p_x;n_y s_y a_y p_y;n_z s_z a_z p_z;0 0 0 1];
%
% T1 = (A(:,:,1))\T_syms == A(:,:,2)*A(:,:,3)


    ia = inv(A(:, :, 1));
    ter2 = A(:, :, 2) * A(:, :, 3);
    eq1 = ter2(3,4) == ia (3,1)*px + ia(3,2) *py;
    %q1 = solve(eq1,q1, 'real',true);

    ib = inv(A(:, :, 2))*ia;
    ter1 = A(:, :, 3);

    eq2 = ter1(2,4) == ib(2,1)*px + ib(2,2)*py + ib(2,3)*pz + ib(2,4)*1;
    eq3 = ter1(1,4) == ib(1,1)*px + ib(1,2)*py + ib(1,3)*pz + ib(1,4)*1;

    %assume(q2>0 & q3>0)
    [q2,q3] = solve([eq2,eq3],[q2 q3], 'real', true);
```

```
    q1 = atan2(-py,-px); %ajustado a mano para dar órdenes de valores
 negativos

    q2a = eval(q2(1));
    q3a = eval(q3(1));

    q2b = eval(q2(2));
    q3b = eval(q3(2));

    toc

%     th = [q1,q2,q3];
%     th2 = rad2deg(th);
%
%     th2(1);
%     th2(2);
%     th2(3);


% fun = @(q) norm([Tra(1);Tra(2);Tra(3)]);


L1 =

   13.5000


L2 =

    15


L3 =

    20

     3

[q1, 27/2, 0, pi/2]

[q2 + pi/2, 0, 15, 0]

[q3, 0, 20, 0]


(:,:,1) =

[       cos(q1),               0,  sin(q1),               0]
[       sin(q1),               0, -cos(q1),               0]
[             0,               1,        0,           27/2]
[             0,               0,        0,               1]

(:,:,2) =
```

```
[cos(q2 + pi/2), -sin(q2 + pi/2),        0, 15*cos(q2 + pi/2)]
[sin(q2 + pi/2),  cos(q2 + pi/2),        0, 15*sin(q2 + pi/2)]
[             0,               0,        1,                 0]
[             0,               0,        0,                 1]

(:,:,3) =

[       cos(q3),        -sin(q3),        0,        20*cos(q3)]
[       sin(q3),         cos(q3),        0,        20*sin(q3)]
[             0,               0,        1,                 0]
[             0,               0,        0,                 1]

[-sin(q2 + q3)*cos(q1), -cos(q2 + q3)*cos(q1),  sin(q1), -5*cos(q1)*(4*sin(q2
 + q3) + 3*sin(q2))]
[-sin(q2 + q3)*sin(q1), -cos(q2 + q3)*sin(q1), -cos(q1), -5*sin(q1)*(4*sin(q2
 + q3) + 3*sin(q2))]
[         cos(q2 + q3),         -sin(q2 + q3),        0,     20*cos(q2 + q3) +
 15*cos(q2) + 27/2]
[                    0,                     0,        0,
                 1]

Warning: Solutions are only valid under certain conditions. To include
parameters and conditions in the solution, specify the 'ReturnConditions'
value as 'true'.
Elapsed time is 44.052097 seconds.
```

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