Get 3D Homography of a projective geometry transform

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- Link: https://github.com/shidafu/ViewConeCalibration.git
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- Algorithom:

Get *s* and [*H*] From:

$$s\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} & h_{13} & h_{14} \\ h_{21} & h_{22} & h_{23} & h_{24} \\ h_{31} & h_{32} & h_{33} & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

By solving:

$$\begin{bmatrix} x_1 & y_1 & z_1 & 1 & 0 & 0 & 0 & 0 & -u_1x_1 & -u_1y_1 & -u_1z_1 \\ 0 & 0 & 0 & 0 & x_1 & y_1 & z_1 & 1 & -v_1x_1 & -v_1y_1 & -v_1z_1 \\ & & & & & & \vdots & & & & \\ x_n & y_n & z_n & 1 & 0 & 0 & 0 & 0 & -u_nx_n & -u_ny_n & -u_nz_n \\ 0 & 0 & 0 & 0 & x_n & y_n & z_n & 1 & -v_nx_n & -v_ny_n & -v_nz_n \end{bmatrix} \begin{bmatrix} h_{11} \\ h_{12} \\ h_{13} \\ h_{14} \\ h_{21} \\ h_{22} \\ \vdots \\ h_{31} \\ h_{32} \end{bmatrix} = \begin{bmatrix}$$

$$[H_{list}] = \left([XYZUV_{list}]^{\mathrm{T}} \cdot [XYZUV_{list}]\right)^{-1} \cdot [XYZUV_{list}]^{\mathrm{T}} \cdot [UV_{list}]$$

$$s = [H] \cdot [XYZ1] \cdot [UV1]^{\mathrm{T}} \cdot \left([UV1] \cdot [UV1]^{\mathrm{T}}\right)$$

- Inputs:

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XYZ----pointNum by cordNum matrix,
            cordNum==3,pointNum>=4,
            [x1,x2,...;
             y1,y2,...;
             z1,z2,...]
UV----pointNum by cordNum matrix,
            cordNum==2,pointNum>=4,
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                        [u1,u2,...;
                         v1,v2,...]
```

- Outputs:

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           H----3 by 3 matrix: [h11 h12 h13 h14;
                                h21 h22 h23 h24;
                                h31 h32 h33 1]
           s----projective para
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function [H,s] = GetHomography3D(XYZ,UV)
% Initial
[cordNum, pointNum]=size(XYZ);
if ~(cordNum==3 || cordNum==4)
    error('Input matrix size error!');
end
XYZ1=ones(4,pointNum,'double');
XYZ1(1:3,:)=XYZ(1:3,:);
UV1=ones(3,pointNum,'double');
UV1(1:2,:)=UV(1:2,:);
HList=zeros(11,1,'double');
XYZUVList=zeros(2*pointNum,11,'double');
UVList=zeros(2*pointNum,1,'double');
for i=1:pointNum
    XYZUVList(i*2-1,:)=[XYZ(1,i), XYZ(2,i), XYZ(3,i), 1, 0, 0, 0, 0,
 -1*UV(1,i)*XYZ(1,i), -1*UV(1,i)*XYZ(2,i), -1*UV(1,i)*XYZ(3,i)];
    XYZUVList(i*2,:)=[0, 0, 0, 0, XYZ(1,i), XYZ(2,i), XYZ(3,i), 1,
 -1*UV(2,i)*XYZ(1,i), -1*UV(2,i)*XYZ(2,i), -1*UV(2,i)*XYZ(3,i)];
    UVList(i*2-1,:)=UV(1,i);
    UVList(i*2,:)=UV(2,i);
end
% Algorithm
HList=inv(XYZUVList'*XYZUVList)*XYZUVList'*UVList;
% Set outputs
H(1,:)=HList(1:4,1);
H(2,:)=HList(5:8,1);
H(3,1:3)=HList(9:11,1);
H(3,4)=1;
s=H*XYZ1*UV1'*inv(UV1*UV1');
```

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Error using GetHomography3D (line 63)
Not enough input arguments.
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