```
% We now use our new homographies to estimate our intrinsic and
 extrinsic
% parameters.

V = [];
for i = 1:4
    H_temp = eval(['Hnew' num2str(i)]);
    h1 = H_temp(:,1);
    h2 = H_temp(:,2);
    h3 = H_temp(:,3);

    v11 = [h1(1)*h1(1), h1(1)*h1(2)+h1(2)*h1(1), h1(2)*h1(2),
 h1(3)*h1(1)+h1(1)*h1(3), h1(3)*h1(2)+h1(2)*h1(3), h1(3)*h1(3)]';
    v12 = [h1(1)*h2(1), h1(1)*h2(2)+h1(2)*h2(1), h1(2)*h2(2),
 h1(3)*h2(1)+h1(1)*h2(3), h1(3)*h2(2)+h1(2)*h2(3), h1(3)*h2(3)]';
    v22 = [h2(1)*h2(1), h2(1)*h2(2)+h2(2)*h2(1), h2(2)*h2(2),
 h2(3)*h2(1)+h2(1)*h2(3), h2(3)*h2(2)+h2(2)*h2(3), h2(3)*h2(3)]';

    V = [V; v12'; (v11-v22)'];
end

[U, Sigma, V_transpose] = svd(V);

b = V_transpose(:,end);

B11 = b(1);
B12 = b(2);
B22 = b(3);
B13 = b(4);
B23 = b(5);
B33 = b(6);

B = [B11, B12, B13; B12, B22, B23; B13, B23, B33];

v0 = (B12*B13 - B11*B23)/(B11*B22 - B12^2);
lambda = B33 - (B13^2 + v0*(B12*B13-B11*B23))/B11;
alpha = sqrt(lambda/B11);
beta = sqrt(lambda*B11/(B11*B22-B12^2));
gamma = -B12*alpha^2*beta/lambda;
u0 = gamma*v0/alpha - B13*alpha^2/lambda;

%Therefore our intrinsic matrix A can be defined as follows,
A = [alpha, gamma, u0; 0, beta, v0; 0, 0, 1];

%Now we calculate the extrinsic parameters and store them for future
 use
for i = 1:4
    H_temp = eval(['Hnew' num2str(i)]);
    h1 = H_temp(:,1);
    h2 = H_temp(:,2);
    h3 = H_temp(:,3);
```

```
    lambda_r = 1/ norm(A\h1);
    r1 = lambda_r*(A\h1);
    r2 = lambda_r*(A\h2);
    r3 = cross(r1,r2);
    t(:,i)  = lambda_r*(A\h3);

    R = [r1, r2, r3];

    [U,S,Vprime] = svd(R);
    Rotation(:,:,i) = U*Vprime;

    disp(["Rotation matrix R for images" files(i)])
    disp(Rotation(:,:,i))
    disp(["Translation vector for images" files(i)])
    disp(t(:,i))

    %We now need to compute the Reprojection Error between the points
 in
    %p_correct and the points we get by projecting grid corners to the
    %image using the new homography
    x1 = p_correct(:,1,i);
    y1 = p_correct(:,2,i);

    H = eval(['Hnew' num2str(i)]);
    points_projection = H*grid_coordinates';
    for j=1:length(points_projection)
        points_projection(:,j) = points_projection(:,j) /
points_projection(3,j);
    end
    points_projection = points_projection';

    x2 = points_projection(:,1);
    y2 = points_projection(:,2);

    disp(["New Homography Reprojection error for >> " files(i)])
    total_err_reprojection = sum(sqrt((x1(:)-x2(:)).^2 + (x1(:)-
x2(:)).^2));
    disp(["Total Reprojection Error (as Euclidean Distance) >> "
 total_err_reprojection]);
    disp(["Average Reprojection Error per point >> "
 total_err_reprojection/80]);

    H = eval(['H' num2str(i)]);
    points_projection_2 = H*grid_coordinates';
    for j=1:length(points_projection_2)
        points_projection_2(:,j) = points_projection_2(:,j) /
points_projection_2(3,j);
    end
    points_projection_2 = points_projection_2';

    x2 = points_projection_2(:,1);
    y2 = points_projection_2(:,2);

    disp(["Part 2 Homography Reprojection error for >> " files(i)]);
```

```
    total_err_reprojection = sum(sqrt((x1(:)-x2(:)).^2 + (x1(:)-
x2(:)).^2));
    disp(["Total Reprojection Error (as Euclidean Distance) >> "
 total_err_reprojection]);
    disp(["Average Reprojection Error per point >> "
 total_err_reprojection/80]);
end
```

```
    "Rotation matrix R for images"    "images2"

    0.1055   -0.9461   -0.3061
    0.4706    0.3187   -0.8228
    0.8760   -0.0573    0.4788

    "Translation vector for images"    "images2"

 -152.3888
  105.1641
  414.4888

    "New Homography Reprojection err…"    "images2"

    "Total Reprojection Error (as Eu…"    "107.6871"

    "Average Reprojection Error per …"    "1.3461"

    "Part 2 Homography Reprojection …"    "images2"

    "Total Reprojection Error (as Eu…"    "205.6325"

    "Average Reprojection Error per …"    "2.5704"

    "Rotation matrix R for images"    "images9"

    0.8640    0.4962    0.0856
   -0.4756    0.8600   -0.1847
   -0.1653    0.1189    0.9791

    "Translation vector for images"    "images9"

  -98.1527
   94.7644
  353.8279

    "New Homography Reprojection err…"    "images9"

    "Total Reprojection Error (as Eu…"    "108.4255"

    "Average Reprojection Error per …"    "1.3553"

    "Part 2 Homography Reprojection …"    "images9"

    "Total Reprojection Error (as Eu…"    "159.1672"
```

```
    "Average Reprojection Error per …"    "1.9896"

    "Rotation matrix R for images"    "images12"

    0.9430   -0.3262    0.0666
    0.3271    0.9450   -0.0028
   -0.0621    0.0244    0.9978

    "Translation vector for images"    "images12"

 -147.9888
  105.8795
  468.9568

    "New Homography Reprojection err…"    "images12"

    "Total Reprojection Error (as Eu…"    "139.4262"

    "Average Reprojection Error per …"    "1.7428"

    "Part 2 Homography Reprojection …"    "images12"

    "Total Reprojection Error (as Eu…"    "236.8602"

    "Average Reprojection Error per …"    "2.9608"

    "Rotation matrix R for images"    "images20"

    0.7321    0.5187    0.4417
   -0.6790    0.6080    0.4114
   -0.0552   -0.6011    0.7973

    "Translation vector for images"    "images20"

 -120.6070
   25.8177
  428.3630

    "New Homography Reprojection err…"    "images20"

    "Total Reprojection Error (as Eu…"    "100.5022"

    "Average Reprojection Error per …"    "1.2563"

    "Part 2 Homography Reprojection …"    "images20"

    "Total Reprojection Error (as Eu…"    "169.431"

    "Average Reprojection Error per …"    "2.1179"
```

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