

Tuesday – part 2

Petr Kropík

4. Curve fitting in 3D

Curve fitting in 3D – linear, polynomial regression, graphical output

Key functions:

`interp2` – formula `ZI = interp2(X,Y,Z,XI,YI)` returns matrix `ZI` containing elements corresponding to the elements of `XI` and `YI` and determined by interpolation within the two-dimensional function specified by matrices `X`, `Y`, and `Z`. `X` and `Y` must be monotonic, and have the same format ("plaid") as if they were produced by `meshgrid`. Matrices `X` and `Y` specify the points at which the data `Z` is given. Out of range values are returned as `NaNs`.

`griddata` – formula `ZI = griddata(x,y,z,XI,YI)` fits a surface of the form $z = f(x,y)$ to the data in the (usually) nonuniformly spaced vectors (x,y,z) . `griddata` interpolates this surface at the points specified by (XI,YI) to produce `ZI`. The surface always passes through the data points. `XI` and `YI` usually form a uniform grid (as produced by `meshgrid`).

Example:

We have measured data of humidity in a room. We want to create a 3D surface graph, but in some points in a room are not measured. We need some interpolation in 3D.

Measured data:

6	5,5	5	4,5	4	3,5	3	2,5	2	1,5	1	0,5	
/	41,7	42,1	43,1	42,9	41,8	42,8	43,1	44,1	44,6	44,2	/	6
/	42,2	43,9	/	/	/	42,9	42,9	42,6	43,1	43,1	43,1	5,5
/	45,5	41,6	41,8	/	/	43,2	43,6	44,3	44,3	44,3	45,2	5
43,3	43,1	/	/	/	/	43,3	43,5	44	42,9	43,3	43,9	4,5
42,2	43,5	/	/	/	/	/	/	44,2	43,8	43,6	42,9	4
41,4	/	/	/	41,4	/	/	/	43,5	42,9	43,1	43,2	3,5
42	41,6	42,3	42,2	42,8	43,1	44	43,6	43,8	42,8	43	42,6	3
41,8	41,9	41,9	42,5	42,2	43,3	43,1	43,6	43,7	43,9	43,1	42,5	2,5
41,8	42,5	41,9	43,2	42,6	43,5	43,2	44,5	43,9	43,7	43	42,5	2
41,9	42,8	42	42,6	44,2	43,4	43,3	43,4	43,7	42,3	43,9	42,5	1,5
41,9	43,9	43,6	41,6	/	/	44,3	43,5	43,3	41,8	43	42,7	1
42,2	42,3	42,1	41,4	/	/	44,6	43,6	42,8	42,4	43,3	43,2	0,5

function data1

```
humidity = [NaN 41.7 42.1 43.1 42.9 41.8 42.8 43.1 44.1 44.6 44.2 NaN
NaN 42.2 43.9 NaN NaN NaN 42.9 42.9 42.6 43.1 43.1 43.1
NaN 45.5 41.6 41.8 NaN NaN 43.2 43.6 44.3 44.3 44.3 45.2
43.3 43.1 NaN NaN NaN NaN 43.3 43.5 44 42.9 43.3 43.9
42.2 43.5 NaN NaN NaN NaN NaN NaN 44.2 43.8 43.6 42.9
41.4 NaN NaN NaN NaN 41.4 NaN NaN NaN 43.5 42.9 43.1 43.2
42 41.6 42.3 42.2 42.8 43.1 44 43.6 43.8 42.8 43 42.6
41.8 41.9 41.9 42.5 42.2 43.3 43.1 43.6 43.7 43.9 43.1 42.5
41.8 42.5 41.9 43.2 42.6 43.5 43.2 44.5 43.9 43.7 43 42.5
41.9 42.8 42 42.6 44.2 43.4 43.3 43.4 43.7 42.3 43.9 42.5
41.9 43.9 43.6 41.6 NaN NaN 44.3 43.5 43.3 41.8 43 42.7
42.2 42.3 42.1 41.4 NaN NaN 44.6 43.6 42.8 42.4 43.3 43.2]
```

```
temp_x = [6 5.5 5 4.5 4 3.5 3 2.5 2 1.5 1 0.5]
```

```
temp_y = [6
5.5
```

```

5
4.5
4
3.5
3
2.5
2
1.5
1
0.5]

% we prepare axes for 3D graph
[X,Y] = meshgrid(temp_x,temp_y);

% interpolation
% we select points without value NaN and their x and y coordinates into
% variables xr, yr, zr
how_many_values = 0;
for cycle_x=1:length(temp_x)
    for cycle_y=1:length(temp_y)
        if ~(isnan(humidity(cycle_y,cycle_x)))
            how_many_values = how_many_values + 1;
            xr(how_many_values) = temp_x(cycle_x);
            yr(how_many_values) = temp_y(cycle_y);
            zr(how_many_values) = humidity(cycle_y,cycle_x);
        end;
    end;
end;

xi = temp_x(1):-0.05:temp_x(end);
yi = temp_y(1):-0.05:temp_y(end);
[XI,YI] = meshgrid(xi,yi);
ZI = griddata(xr,yr,zr,XI,YI,'cubic');
surf(XI,YI,ZI);

hold on % to hold previous graph

plot3(xr,yr,zr,'.r');
hold off
shading interp % coloured interpolation
colorbar % colour scheme legend

% graph including contours
figure
surfc(XI,YI,ZI);
shading interp % coloured interpolation
colorbar % colour scheme legend

% measured data graph
figure
surf(X,Y,humidity);
shading interp % coloured interpolation
colorbar % colour scheme legend

% three graphs in column (3x1 graph), we used the first one
subplot(3,1,1)
surf(XI,YI,ZI)
shading interp % coloured interpolation
colorbar % colour scheme legend

% three graphs in column (3x1 graph), we used the second one
subplot(3,1,2)
surf(XI,YI,ZI)
shading interp % coloured interpolation
colorbar % colour scheme legend

% three graphs in column (3x1 graph), we used the third one

```

```
subplot(3,1,3)
surf(XI,YI,ZI)
shading interp % coloured interpolation
colorbar % colour scheme legend

figure % new figure creating
surf(XI,YI,ZI)
shading interp % coloured interpolation
colorbar % colour scheme legend

% changing of colormap
% using colormapeditor - for exmple to setup threshold values
colormap(copper)

figure % new figure creating
pcolor(XI,YI,ZI)
shading interp % coloured interpolation
colorbar % colour scheme legend

figure % new figure creating
contour(XI,YI,ZI)

figure % new figure creating
mesh(XI,YI,ZI)
hold on
contour3(XI,YI,ZI,'k') % 3D contours in black
hold off
```