Relaxation Method : تشابه با معادله ي توزيع دما

$$\frac{\partial V}{\partial t} = D \ \nabla^2 V$$

D : رسانندگي گرمائي محيط . حتماً حل مانا دارد

$$V(x, y, t) \rightarrow V_{i,j}^{n}$$

$$\frac{\partial V}{\partial t} \approx \frac{V_{i,j}^{n+1} - V_{i,j}^{n}}{\epsilon}$$

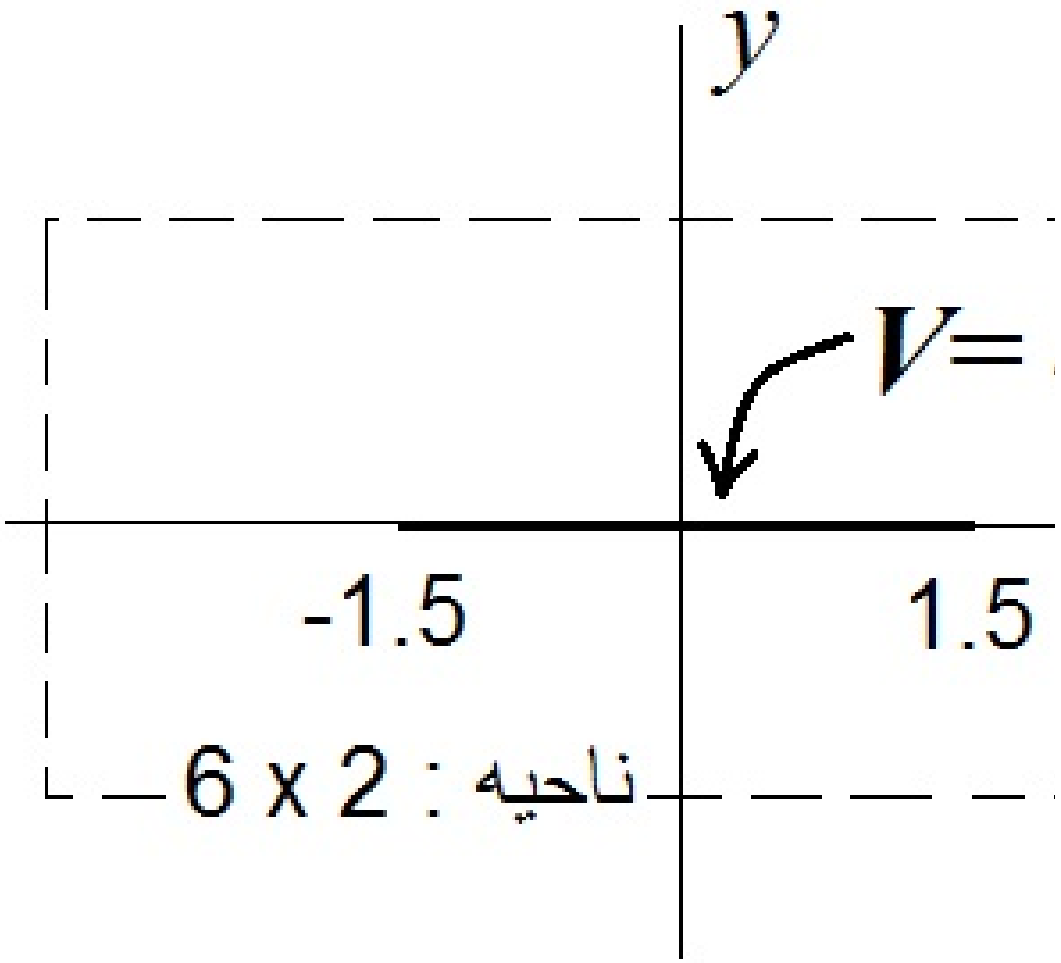
$$\frac{V_{i,j}^{n+1} - V_{i,j}^{n}}{\epsilon D} = \frac{V_{i+1,j}^{n} + V_{i-1,j}^{n} + V_{i,j+1}^{n} +}{h^2}$$

پارامترها اتخاب با :

$$\epsilon D = h^2/4$$

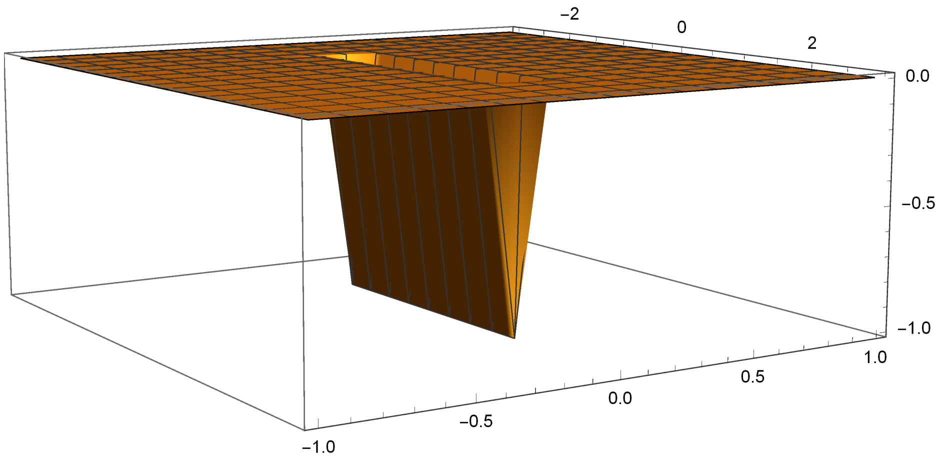
$$V_{i,j}^{n+1} = (V_{i+1,j}^{n} + V_{i-1,j}^{n} + V_{i}$$

مثال : پتانسيل يک يتيغه رسانا




```
del = 0.1; imax2 = 30; jmax2 = 10;
Vb[1][i_, j_] := If[-15 ≤ i ≤ 15 && j == 0, -1, 0]
```

```
ListPlot3D[Table[Vb[1][i, j], {j, -jmax2, jmax2}, {i, -imax2, imax2}],
 DataRange → {{-3, 3}, {-1, 1}}, PlotRange → All]
```




```
Vb[n_][i_, j_] := If[-15 ≤ i ≤ 15 && j == 0, -1,
  Vb[n][i, j] = (Vb[n - 1][i + 1, j] +
     Vb[n - 1][i - 1, j] + Vb[n - 1][i, j + 1] + Vb[n - 1][i, j - 1]) / 4]

Table[Vb[5][i, j], {j, -jmax2, jmax2}, {i, -imax2, imax2}] // MatrixForm
```

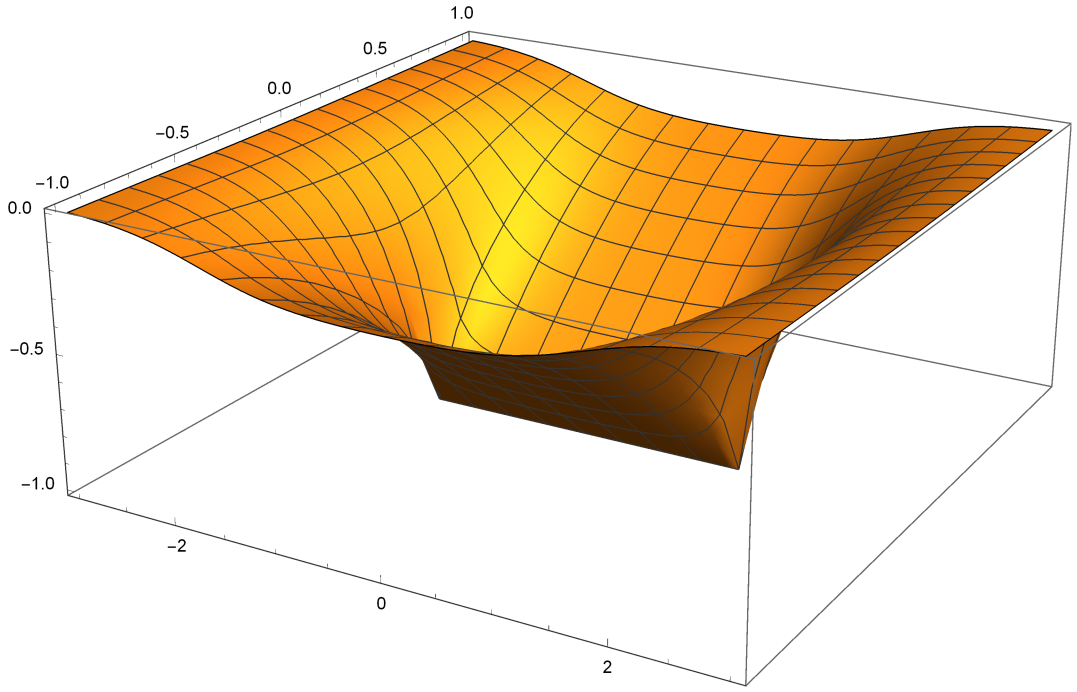
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{64}$	$-\frac{7}{256}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$
0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{3}{128}$	$-\frac{15}{256}$	$-\frac{37}{256}$	$-\frac{43}{256}$	$-\frac{23}{128}$	$-\frac{23}{128}$	$-\frac{23}{128}$	$-\frac{23}{128}$
0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{64}$	$-\frac{13}{256}$	$-\frac{13}{64}$	$-\frac{107}{256}$	$-\frac{63}{128}$	$-\frac{129}{256}$	$-\frac{65}{128}$	$-\frac{65}{128}$	$-\frac{65}{128}$
0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{256}$	$-\frac{1}{64}$	$-\frac{7}{64}$	$-\frac{43}{128}$	-1	-1	-1	-1	-1	-1
0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{64}$	$-\frac{13}{256}$	$-\frac{13}{64}$	$-\frac{107}{256}$	$-\frac{63}{128}$	$-\frac{129}{256}$	$-\frac{65}{128}$	$-\frac{65}{128}$	$-\frac{65}{128}$
0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{3}{128}$	$-\frac{15}{256}$	$-\frac{37}{256}$	$-\frac{43}{256}$	$-\frac{23}{128}$	$-\frac{23}{128}$	$-\frac{23}{128}$	$-\frac{23}{128}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{64}$	$-\frac{7}{256}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$	$-\frac{5}{128}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$	$-\frac{1}{256}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

```
m = 50;
N[Max[Table[Abs[Vb[m][i, j] - Vb[m - 1][i, j]],
    {j, -jmax2, jmax2}, {i, -imax2, imax2}]]]
```

```
0.00494417
```

```
acc = 0.002; m = 1;
While[Max[Table[Abs[Vb[m + 1][i, j] - Vb[m][i, j]],
     {j, -jmax2, jmax2}, {i, -imax2, imax2}]] ≥ acc, m++]
m
ListPlot3D[Table[Vb[m][i, j], {j, -jmax2, jmax2}, {i, -imax2, imax2}],
 DataRange → {{-3, 3}, {-1, 1}}, PlotRange → All]
```

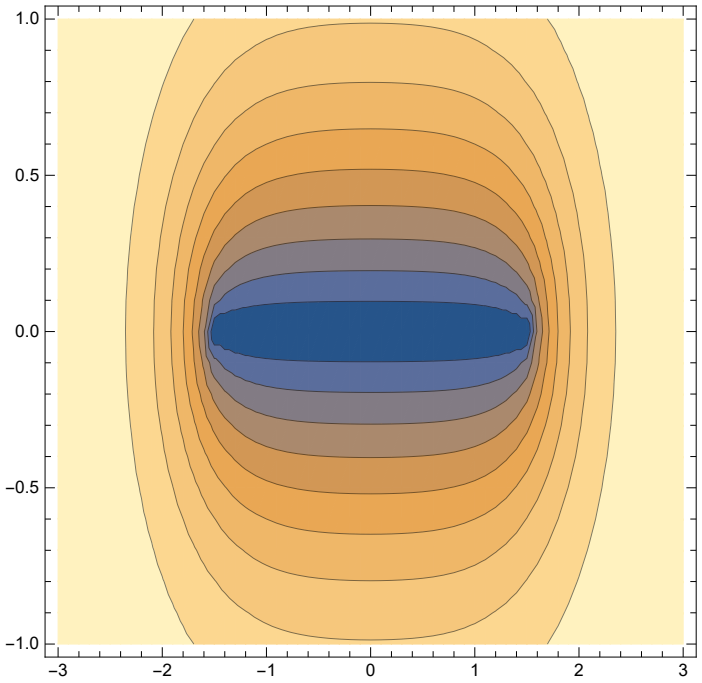
```
120
```



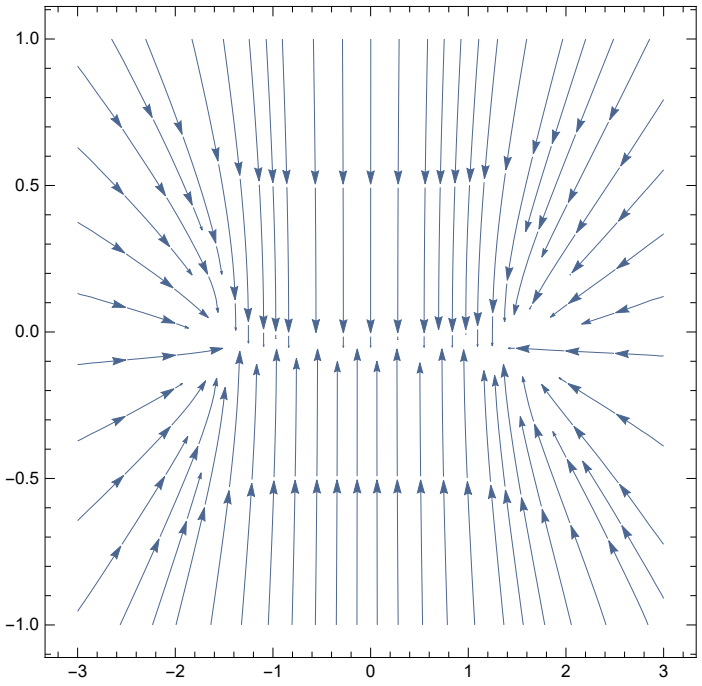

```
Vb[120][13, 8] // N
```

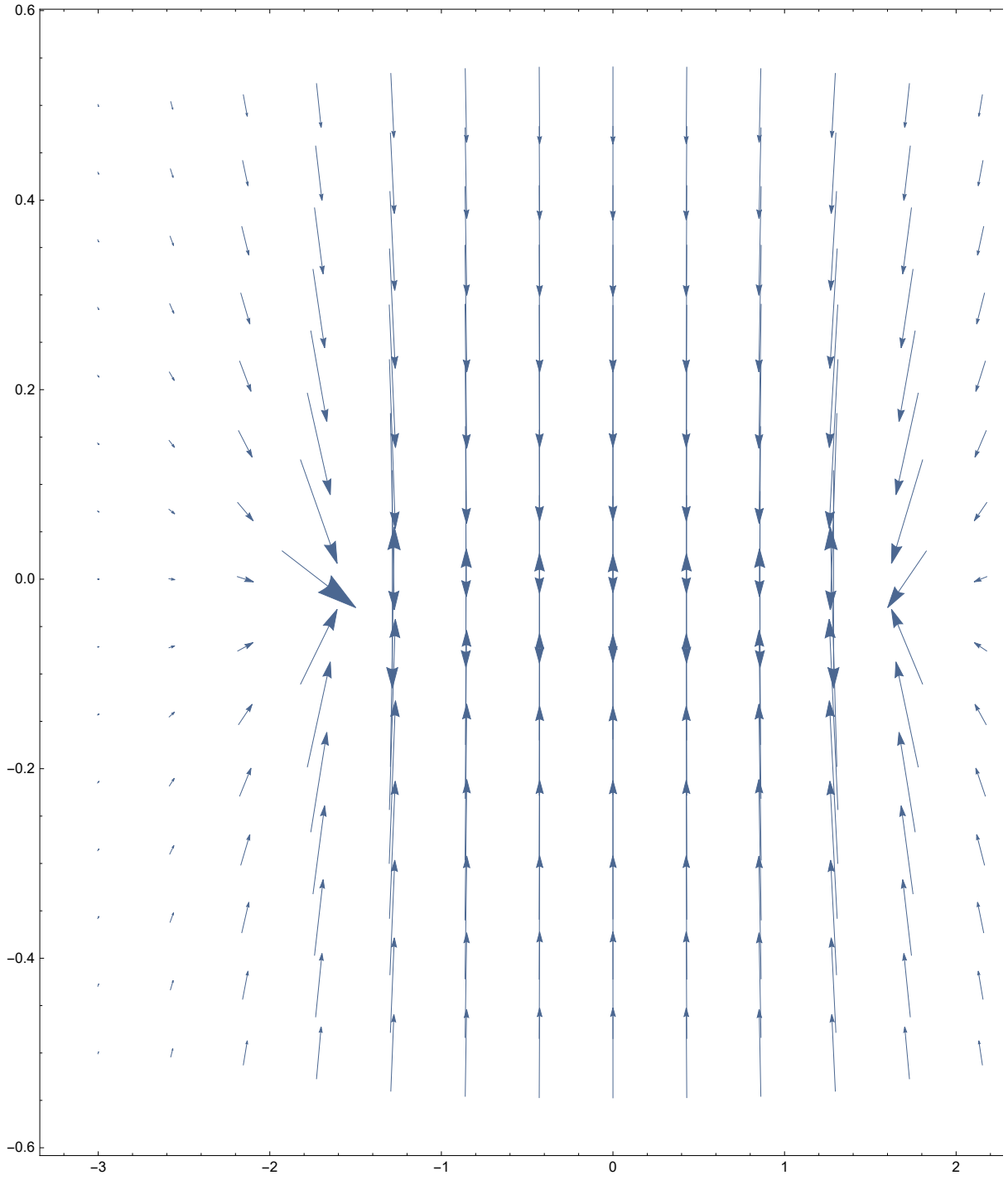
```
-0.231951
```

```
ListContourPlot[Table[Vb[m][i, j], {j, -jmax2, jmax2}, {i, -imax2, imax2}],
 DataRange → {{-3, 3}, {-1, 1}}, PlotRange → All]
```




```
ElecVb = -Table[{Vb[m][i + 1, j] - Vb[m][i, j], Vb[m][i, j + 1] - Vb[m][i, j]},
    {i, -imax2 + 1, imax2 - 1}, {j, -jmax2 + 1, jmax2 - 1}];
ListStreamPlot[ElecVb, DataRange → {{-3, 3}, {-1, 1}}, PlotRange → All]
ListVectorPlot[ElecVb, DataRange → {{-3, 3}, {-0.5, 0.5}}, PlotRange → All]
```




0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−3
−2
−1
0
1
2