

# Excel Solver

The image illustrates the steps to enable the Excel Solver Add-in. The process is as follows:

- Click on the **FILE** tab in the top ribbon.
- Click on **Options** in the left-hand menu.
- In the **Excel Options** dialog box, select **Add-Ins** from the left-hand list.
- Under **Add-Ins available:**, check the **Solver Add-in** checkbox.
- Click the **OK** button in the **Add-Ins** dialog box.
- Click on the **DATA** tab in the top ribbon.
- Click on the **Solver** icon in the **DATA** tab ribbon.

The **Excel Options** dialog box shows the following details for the **Solver Add-in**:

- Name:** Solver Add-in
- Active Application Add-ins:** No Active Application Add-ins
- Inactive Application Add-ins:** Analysis ToolPak, Analysis ToolPak - VBA, Date (XML), Euro Currency Tools, Inquire, Microsoft Actions Pane 3, Microsoft Office PowerPoint for Excel 2013, Power View, Solver Add-in
- Document Related Add-ins:** No Document Related Add-ins
- Disabled Application Add-ins:** Add-in: Analysis ToolPak, Publisher: Microsoft Corporation, Compatibility: No compatibility, Location: C:\Program Files\Microsoft Office\Office14\Analysis ToolPak.xla, Description: Provides data analysis tools.

The **Add-Ins** dialog box shows the following details for the **Solver Add-in**:

- Add-Ins available:** Analysis ToolPak, Analysis ToolPak - VBA, Euro Currency Tools, Solver Add-in
- Buttons:** OK, Cancel, Browse..., Automation...

# Excel Solver – Въведение. Задача 1 а)

## Решаване на оптимизационна задача с Excel-Solver

Като се използва **Excel-Solver** да се намери **най-малкото разстояние от точката с координати  $X_p$  и  $Y_p$  до кривата  $y=f(x)$** , зададена по-долу. Оптимизацията да се направи при ограничение  $0 \leq x \leq 100$  (*т.е. разглеждане на функцията в интервала от 0 до 100*).

Координатите на точката се избират по следния начин:

$X_p$  = числото получаващо се от последните 3 цифри на факултетния ви номер, и  
 $Y_p$  =  $100 - X_p$  - номера на групата ви.

Например, ако факултетният ви номер е XXXXXX245, а групата ви е 40, то следва:

$X_p = 245$ , а  $Y_p = 100 - 245 - 40 = -185$

Функцията е зададена с уравнението:

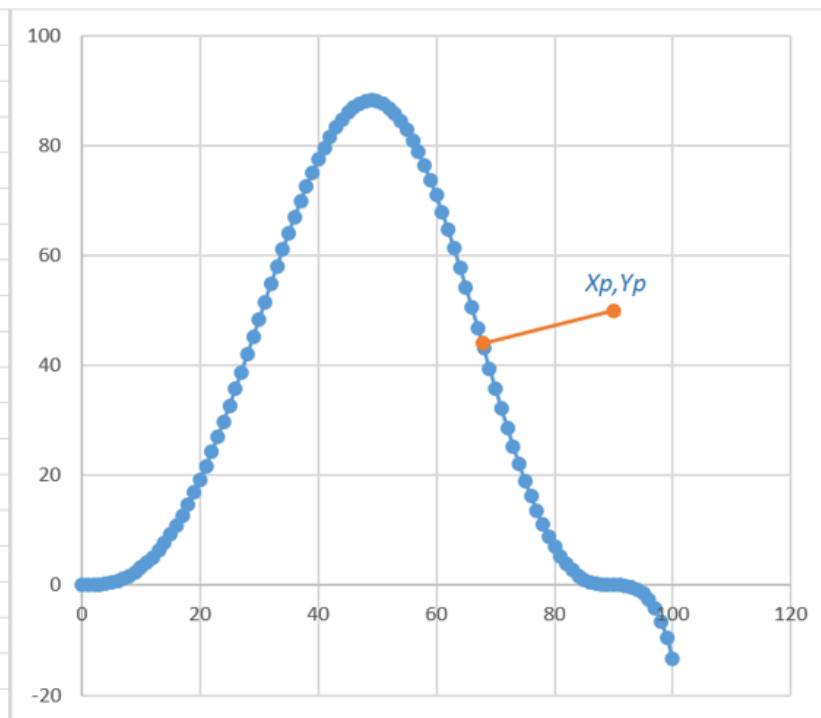
$$y = \frac{(x \cdot \cos(x) - \sin(90 + x))^3}{400}, \text{ като } 0 \leq x \leq 100$$

# Excel Solver – Въведение. Задача 1 б)

Примерно подобно решение е показано на фигурата по-долу.

	Променлива X	
0<=	67.77112	<=100
Ограничаваме търсенето от 0 до 100		
Функция Y		
	44.02433	
Дадена точка с координати Xp,Yp:		
Xp=	90	
Yp=	50	
Най-малкото разстояние от точката до кривата Y:		
	23.01807	

$$y = \frac{(x \cdot \cos(x) + \sin(90 + x))^3}{400}$$



## **ВНИМАНИЕ!**

*Изпращате файл с решението с име само вашия факултетен номер и с разширение .xlsx, без да се изисква да правите графична презентация на решението, като показаната на примера.*

# Excel Solver – Минимално разстояние 2 а)

Solver\_Task\_Distance.xlsx - Excel

Home Insert Page Layout Formulas Data Review View LOAD TEST TEAM Tell me what you want to do...

From Access From Web From Text From Other Sources Get External Data Existing Connections New Query Recent Sources Get & Transform Show Queries From Table Refresh All Recent Sources Get & Transform Connections Properties Edit Links Sort Filter Clear Reapply Advanced Text to Columns Flash Fill Remove Duplicates Validation Data Consolidate Relationships Manage Data Model What-If Analysis Forecast Sheet Group Ungroup Subtotal Show Detail Hide Detail Outline

E12  $=\text{SQRT}((\text{E8}-\text{E3})^2+(\text{E9}-\text{E5})^2)$

x	y	Променлива X	Функция Y
0	0.0025	0 <= 57.7848 <= 100	Ограничаваме търсенето от 0 до 100
1	0.01999		
2	0.06738		
3	0.15934		
4	0.31022		
5	0.53386		
6	0.84348		
7	1.25159		
8	1.76981		
9	2.40879		
10	3.17814		
11	4.08624		
12	5.14024		
13	6.34594		
14	7.70772		
15	9.2285		
16	10.9097		
17	12.7511		
18	14.7509		
19	16.906		
20	19.2112		
21	21.6602		

Дадена точка с координати  $X_p, Y_p$ :

$X_p = 90$   
 $Y_p = 90$

Най-малкото разстояние от точката до кривата: 34.7611

Сolver Parameters

Set Objective:  $\$E\$12$

To: ☐ Max ☒ Min ☐ Value Of: 0

By Changing Variable Cells:  $\$E\$3$

Subject to the Constraints:

$\$E\$3 \leq 100$   
 $\$E\$3 \geq 0$

☒ Make Unconstrained Variables Non-Negative

Select a Solving Method: GRG Nonlinear

Solving Method: Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Help Solve Close

# Excel Solver – Минимално разстояние 2 б)

НАМИРАНЕ НА НАЙ-МАЛКО РАЗСТОЯНИЕ ОТ ТОЧКА Д					
1	A	B	C	D	F
2	x	y		Променлива X	
3		0	0.0025	0 <= 57.7848 <= 100	
4		1	0.01999	Функция Y	
5		2	0.06738	76.9418	
6		3	0.15934		
7		4	0.31022	Дадена точка с коо	
8		5	0.53386	Xp= 90	
9		6	0.84348	Yp= 90	
10		7	1.25159		
11		8	1.76981	Най-малкото разс	
12		9	2.40879	34.7611	
13		10	3.17814		
14		11	4.08624		
15		12	5.14024		
16		13	6.34594		
17		14	7.70772		
18		15	9.2285		
19		16	10.9097		
20		17	12.7511		
21		18	14.7509		
22		19	16.906		
23		20	19.2112		
24		21	21.6602		

**Solver Parameters**

**ЦЕЛ**

Set Objective: SE\$12

To: ☐ Max ☒ Min ☐ Value Of: 0

**ПРОМЕНЛИВИ**

By Changing Variable Cells: SE\$3

**ОГРАНИЧЕНИЯ**

Subject to the Constraints:

SE\$3 <= 100  
SE\$3 >= 0

☒ Make Unconstrained Variables Non-Negative

**МЕТОД**

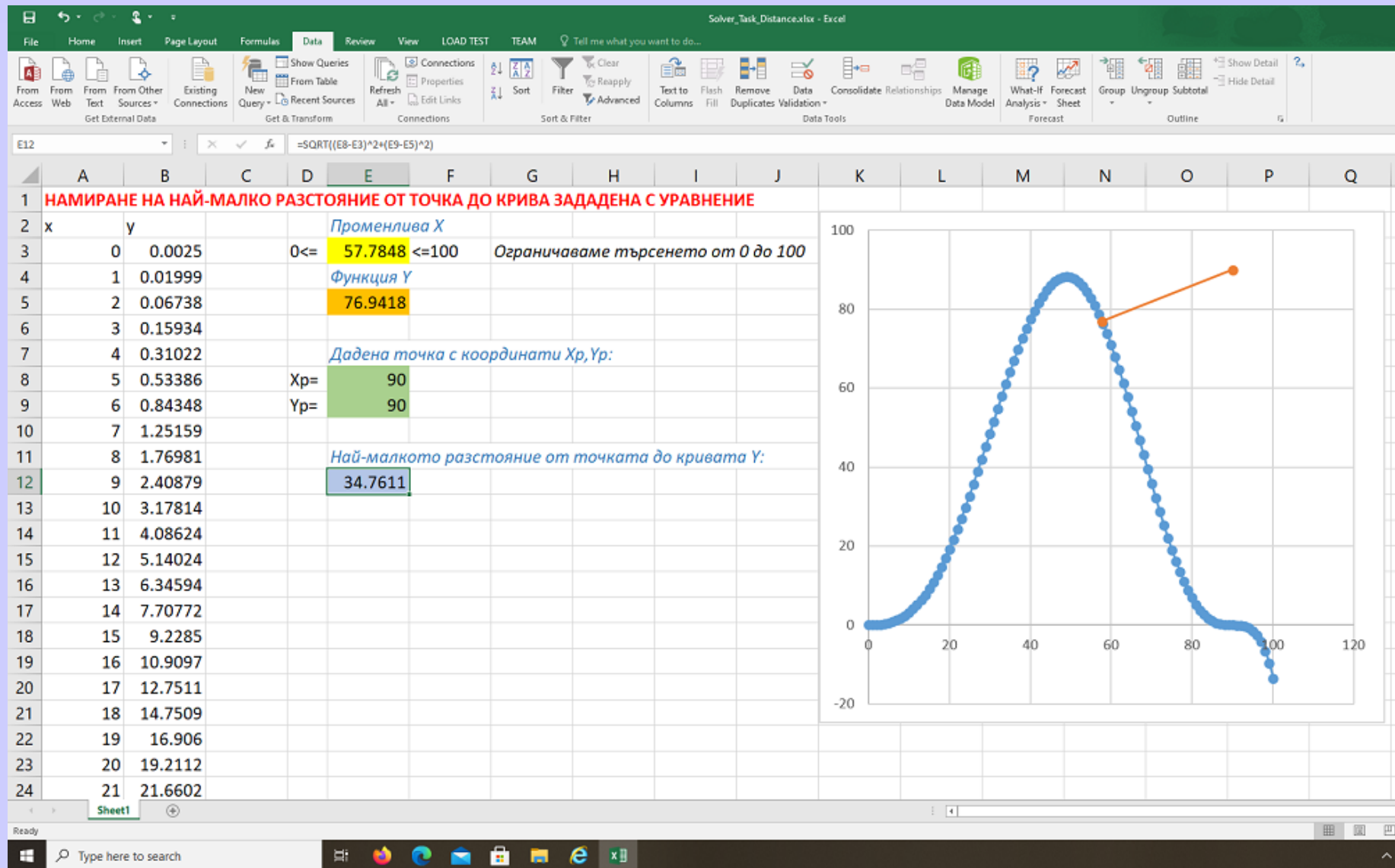
Select a Solving Method: GRG Nonlinear

Solving Method

Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

**СТАРТ** **Solve** **Close**

# Excel Solver – Минимално разстояние 3

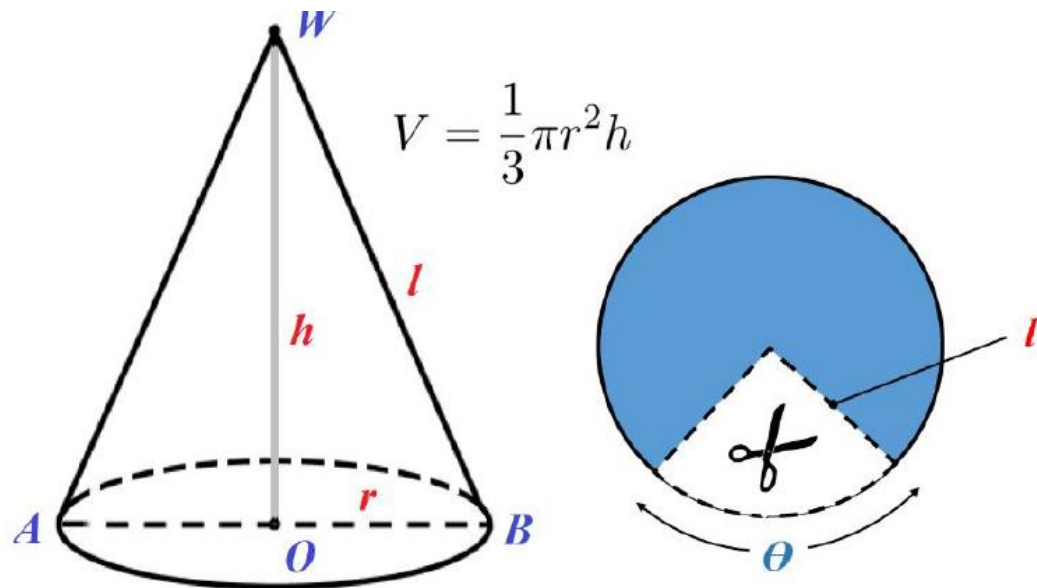


# Оптимизационна задача – пример а)

## Решаване на оптимизационна задача с Excel-Solver

Разполагате с лист ламарина с формата на кръг с радиус в милиметри равен на номера на групата ви умножен по 10 плюс числото получаващо се от последните 3 цифри на факултетния ви номер.

Какъв сектор от кръга следва да бъде отрязан и премахнат т.е.  $\Theta = ?$  в градуси , така че конусът получен от оставащото парче да има максимален обем  $V_{\max}$  и колко е този обем в литри  $V_{\max} = ?$





# Оптимизационна задача – пример б)

**ДАДЕНО:** радиусът на кръга

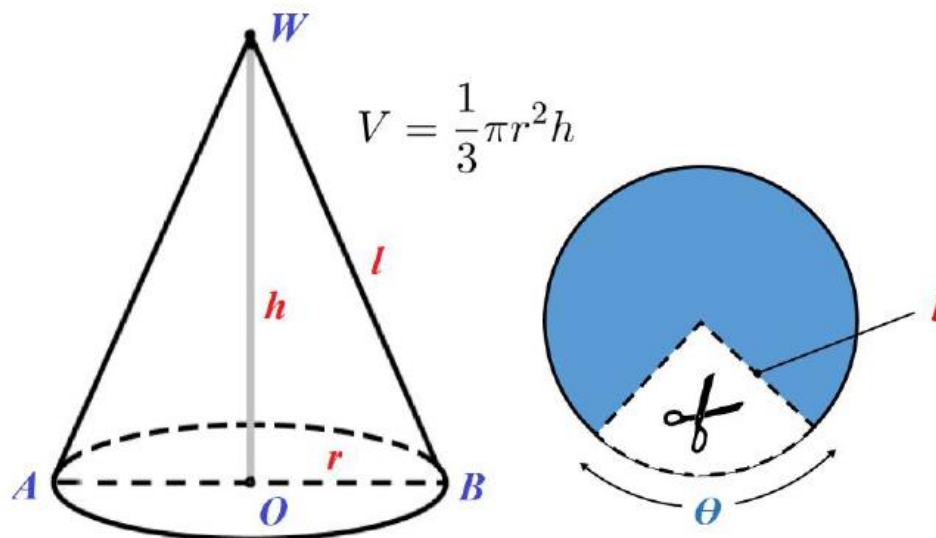
Например, ако факултетният ви номер е XXXXXX245, а групата ви е 40, то следва:

$$l = 40 \cdot 10 + 245 = 645 \text{ mm}$$

**ТЪРСИ СЕ:**

$\theta = ?$  в градуси

$V_{\max} = ?$  в литри



**ВНИМАНИЕ!**

Изпратете файл с решението с име само вашия факултетен номер и с разширение xlsx



# Excel Solver – Две променливи

$$F(x_1, x_2) = (x_2 - x_1^2)^2 + (1 - x_1)^2$$

Функция на две променливи				
ПРОМЕНЛИВИ	x1=	0	x2=	0
ОГРАНИЧЕНИЯ	-5 <=x1<=	5	-5 <=x2<=	5
ЦЕЛЕВА ФУНКЦИЯ	F(x1,x2)=	1		

**Solver Parameters**

Set Objective:

To: ☐ Max ☒ Min ☐ Value Of:

By Changing Variable Cells:

Subject to the Constraints:

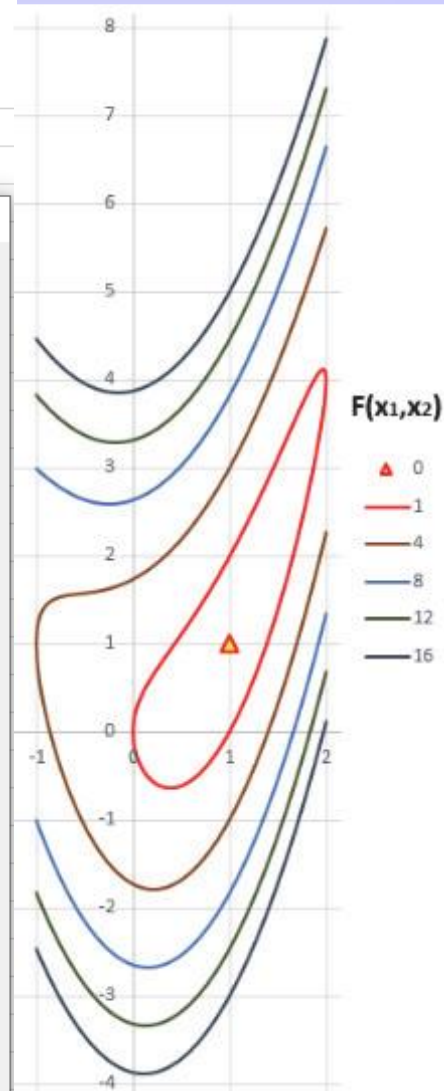
- 
- 
- 
- 

☒ Make Unconstrained Variables Non-Negative

Select a Solving Method:

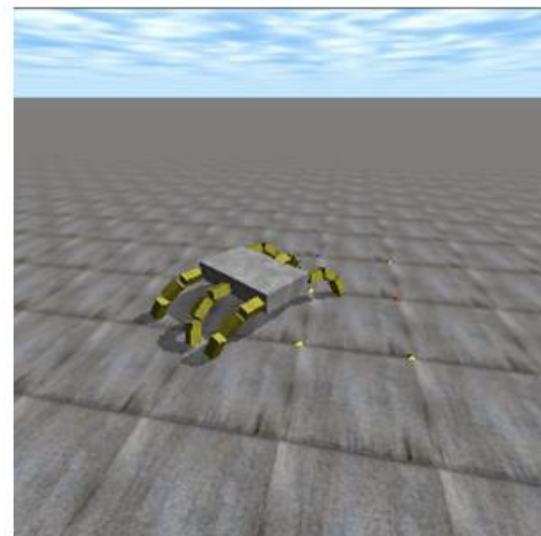
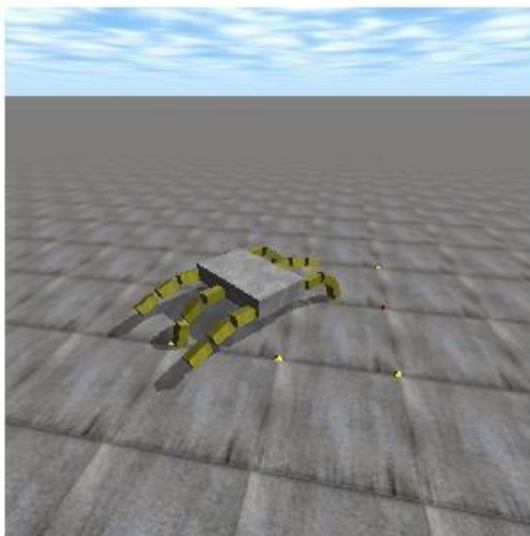
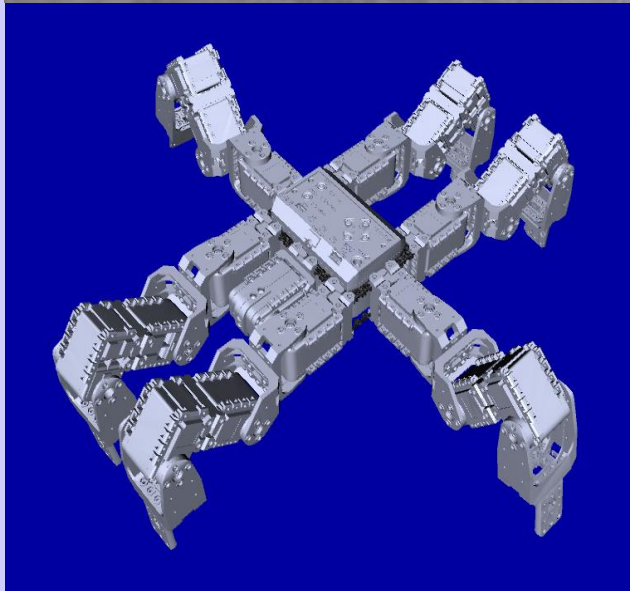
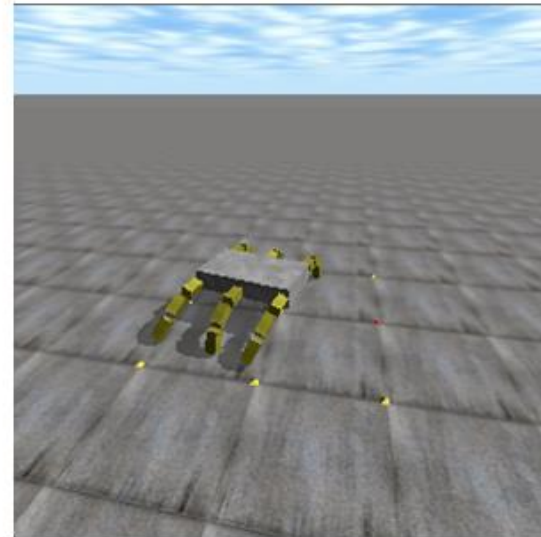
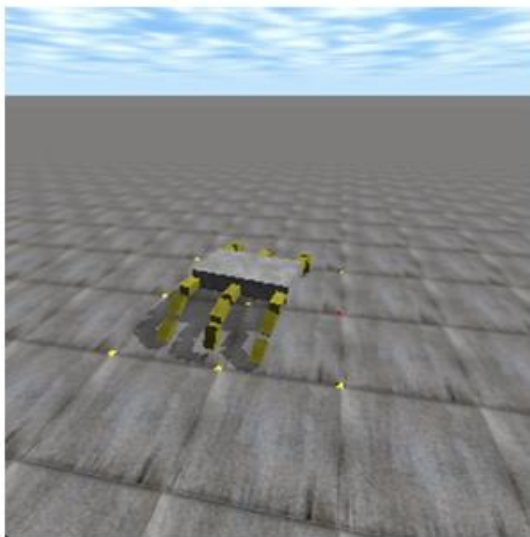
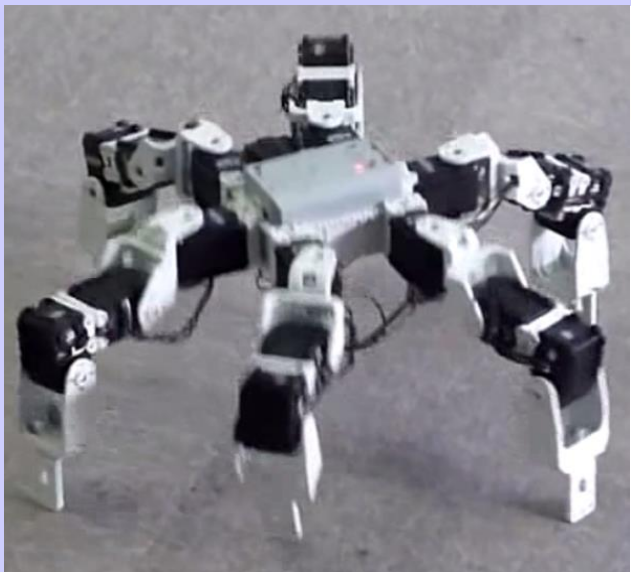
Options

Help Solve Close

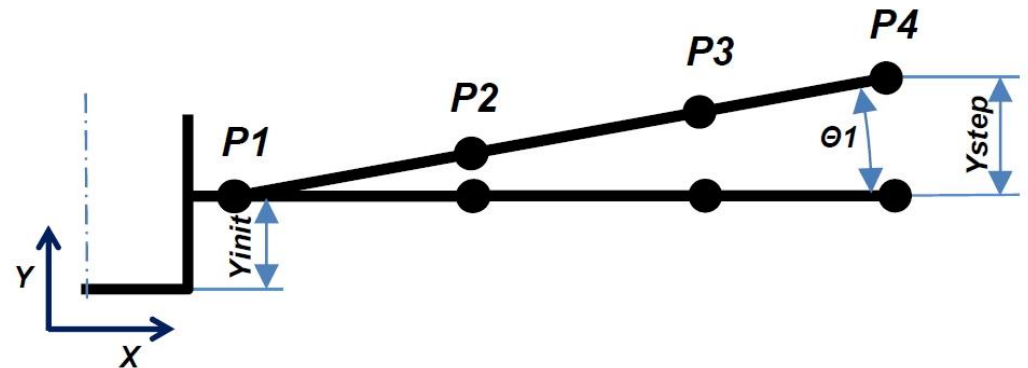
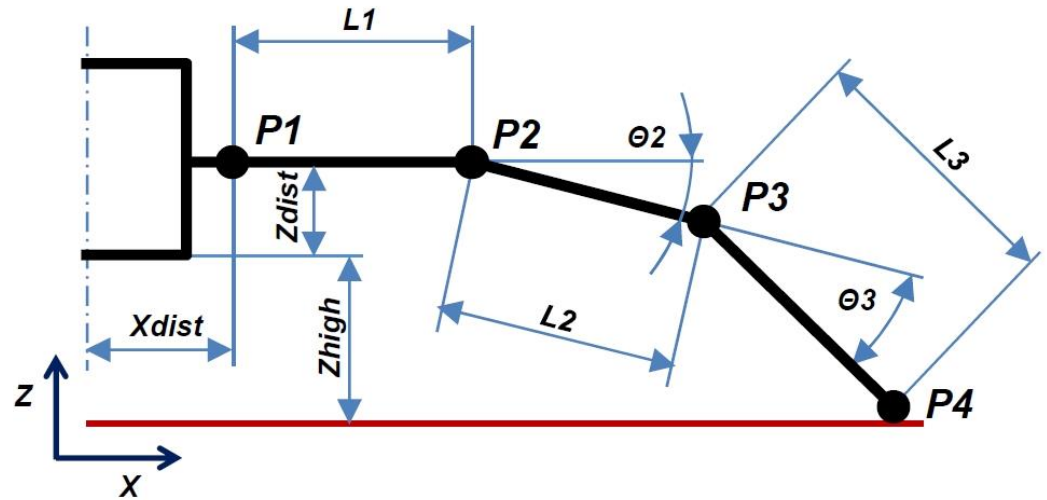
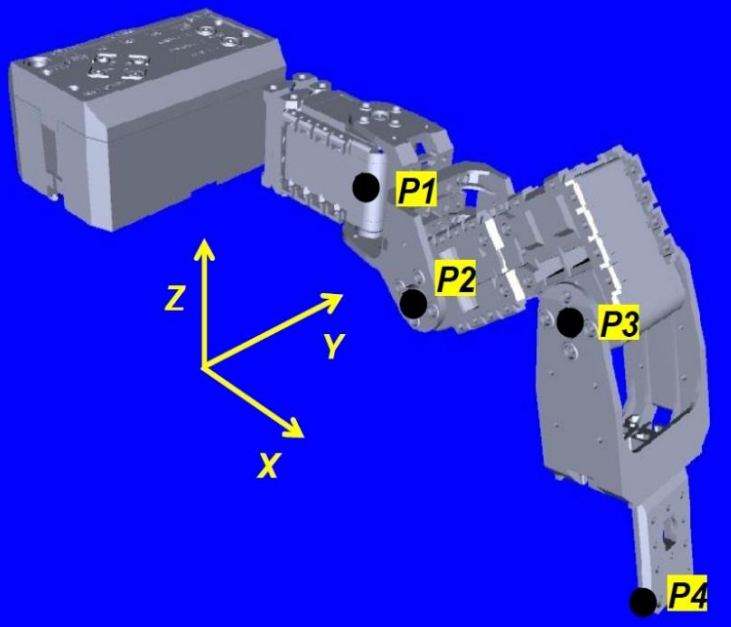
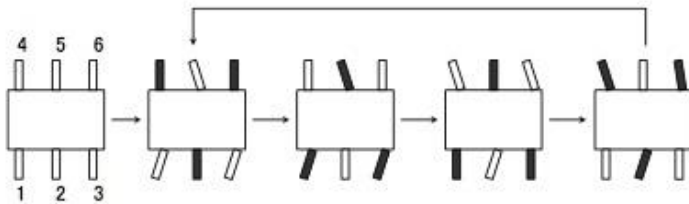
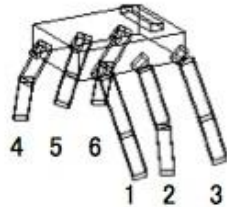


Функция на две променливи				
ПРОМЕНЛИВИ	x1=	1	x2=	1
ОГРАНИЧЕНИЯ	-5 <=x1<=	5	-5 <=x2<=	5
ЦЕЛЕВА ФУНКЦИЯ	F(x1,x2)=	0.00000		

# Ходещ робот - задача



# Excel Solver – Эксперимент с ходящ робот



Goal  $Y_{step} = \text{MAX}$

Constraints  $Z_{high} > \text{MIN distance from the ground,}$   
 $\Theta_{min} < \theta_{1,2,3} < \Theta_{max}$



# Оптимизация в Excel Solver

Robot\_Step.xlsx - Excel



## 1 Walking Robot - Step Optimization

### 2 Parameters of Model:

3 L1= 100 mm

4 L2= 100 mm

5 L3= 100 mm

6 Xdist= 50 mm

7 Zdist= 20 mm

### 8 Constraints

### 9 Variable Cells

10  $\theta 1$ = 70 deg 0 70

11  $\theta 2$ = 9 deg 0 70

12  $\theta 3$ = 0 deg 0 70

13 Zhig= 10 mm 10

### 15 Objective Cell

16 Ystep= 279.78 mm

**Solver Parameters**

Set Objective:

To: ☒ Max ☐ Min ☐ Value Of:

By Changing Variable Cells:

Subject to the Constraints:

- \$B\$10 <= \$E\$10
- \$B\$10 >= \$D\$10
- \$B\$11 <= \$E\$11
- \$B\$11 >= \$D\$11
- \$B\$12 <= \$E\$12
- \$B\$12 >= \$D\$12
- \$B\$13 >= \$D\$13

☒ Make Unconstrained Variables Non-Negative

Select a Solving Method:

Solving Method

Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.