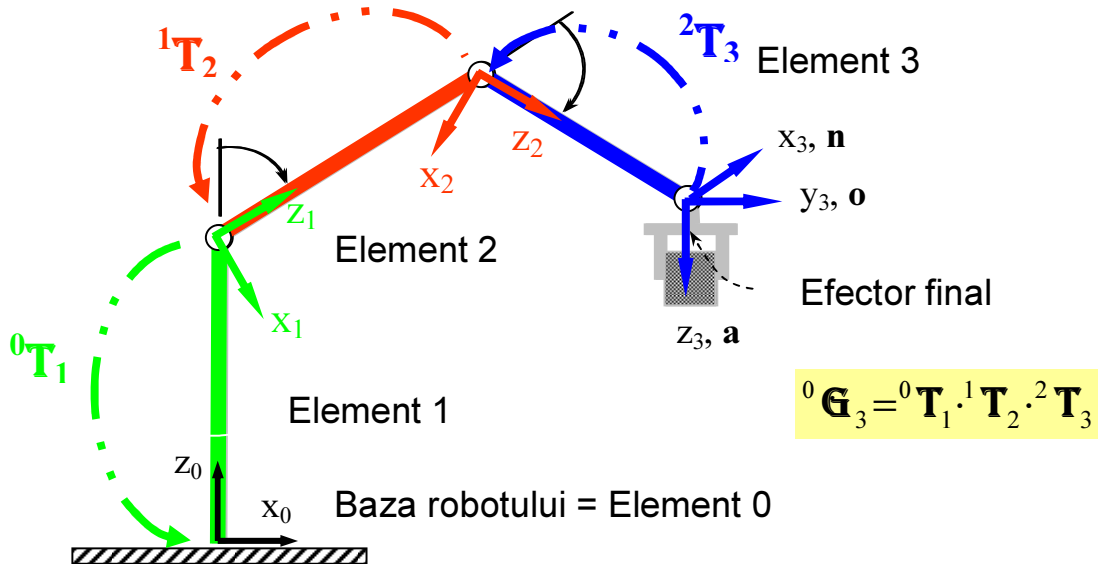


TEME BAZELE ROBOTICII

1. Modelul geometric al unui robot



Spațiul cuplelor

n variable
(q_1, \dots, q_n)

MG - DIRECT

Spațiul operațional

6 variable
($x, y, z, \alpha, \beta, \gamma$)
sau
12 variabile
($\mathbf{n}, \mathbf{o}, \mathbf{a}, \mathbf{p}$)

MG - INVERS

$${}^0G_n = {}^0T_1 \cdot {}^1T_2 \cdot \dots \cdot {}^{i-1}T_i \cdot {}^iT_{i+1} \cdot \dots \cdot {}^{n-1}T_n$$

$f(q_1)$

$f(q_2)$

$f(q_i)$

$f(q_{i+1})$

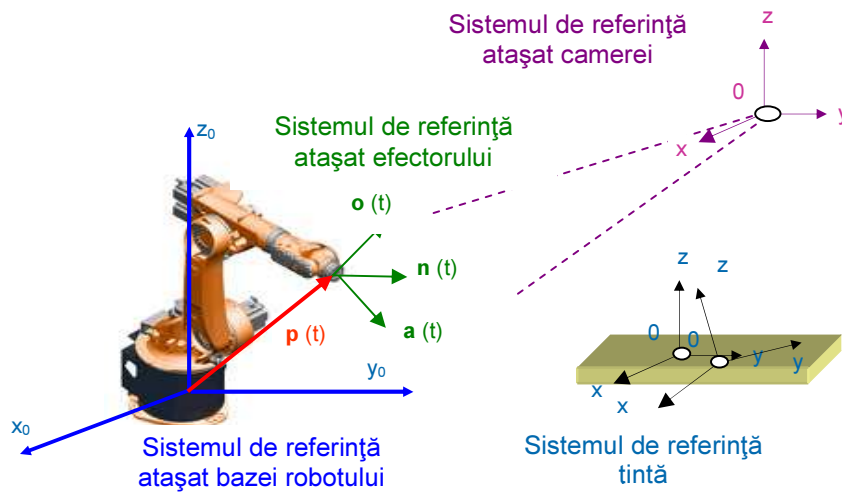
$f(q_n)$

$${}^0G = \begin{bmatrix} n_x & o_x & a_x & p_x \\ n_y & o_y & a_y & p_y \\ n_z & o_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$${}^{i-1}T_i = f(\alpha_i, l_i, \theta_i, d_i)$$

$$\begin{array}{llll} n_x = f_1(q_1, \dots, q_n) & o_x = f_4(q_1, \dots, q_n) & a_x = f_7(q_1, \dots, q_n) & p_x = f_{10}(q_1, \dots, q_n) \\ n_y = f_2(q_1, \dots, q_n) & o_y = f_5(q_1, \dots, q_n) & a_y = f_8(q_1, \dots, q_n) & p_y = f_{11}(q_1, \dots, q_n) \\ n_z = f_3(q_1, \dots, q_n) & o_z = f_6(q_1, \dots, q_n) & a_z = f_9(q_1, \dots, q_n) & p_z = f_{12}(q_1, \dots, q_n) \end{array}$$

2. Modelul diferențial al unui robot



$$\mathbf{D} = \mathbf{J}_r \cdot \mathbf{D}_q$$



Model diferențial

Spațiul cuplelor

n variable

${}^{G_n} \mathbf{D}$

(dq_1, \dots, dq_n)

$${}^{G_n} \mathbf{D} = \mathbf{J}_r \cdot \mathbf{D}_q$$

MDiferențial

- DIRECT

Spațiul operațional

6 variable

\mathbf{D}_q

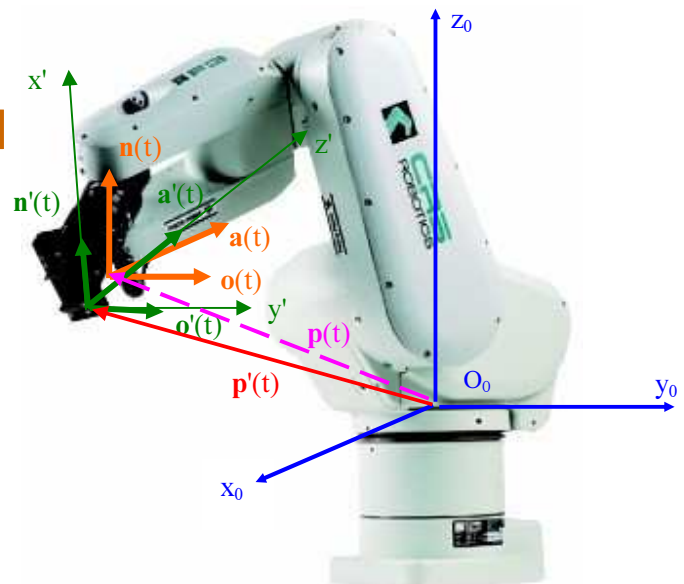
$(dx, dy, dz, \delta_x, \delta_y, \delta_z)$

$$\mathbf{D}_o = (\mathbf{J}_r)^{-1} \cdot {}^{G_n} \mathbf{D}$$

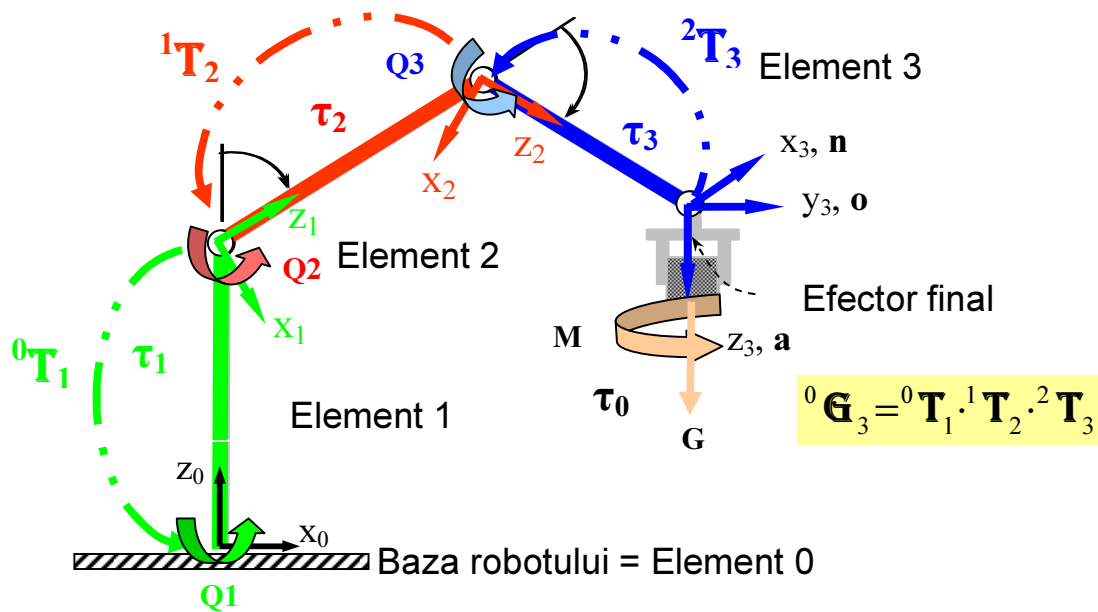
MDiferențial

- INVERS

$${}^0 \mathcal{G}' = {}^0 \mathcal{G}^r = {}^0 \mathcal{G} + {}^0 d\mathcal{G}$$



3. Calculul torsorilor pentru elementele și cuplele unui robot



Torsori in cuple $\tau_0 \longrightarrow Q$

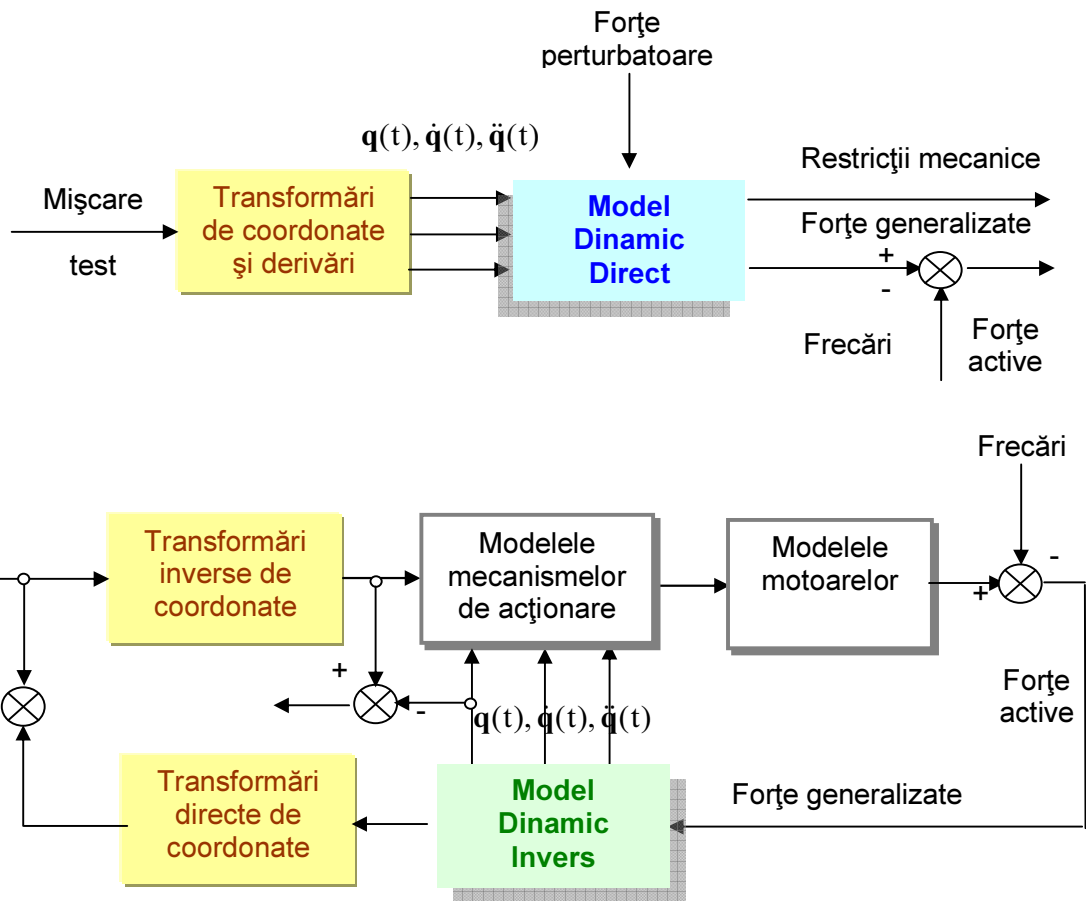
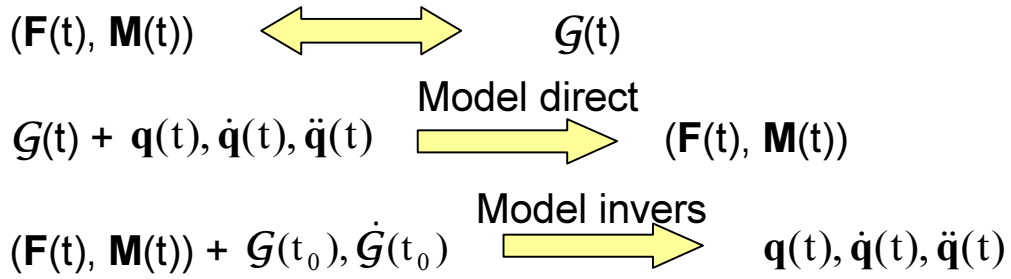
$$Q = [J_r]^T \cdot G_n \tau_0$$

Torsori ce actioneaza asupra elementelor robotului $\tau_0 \longrightarrow \tau$

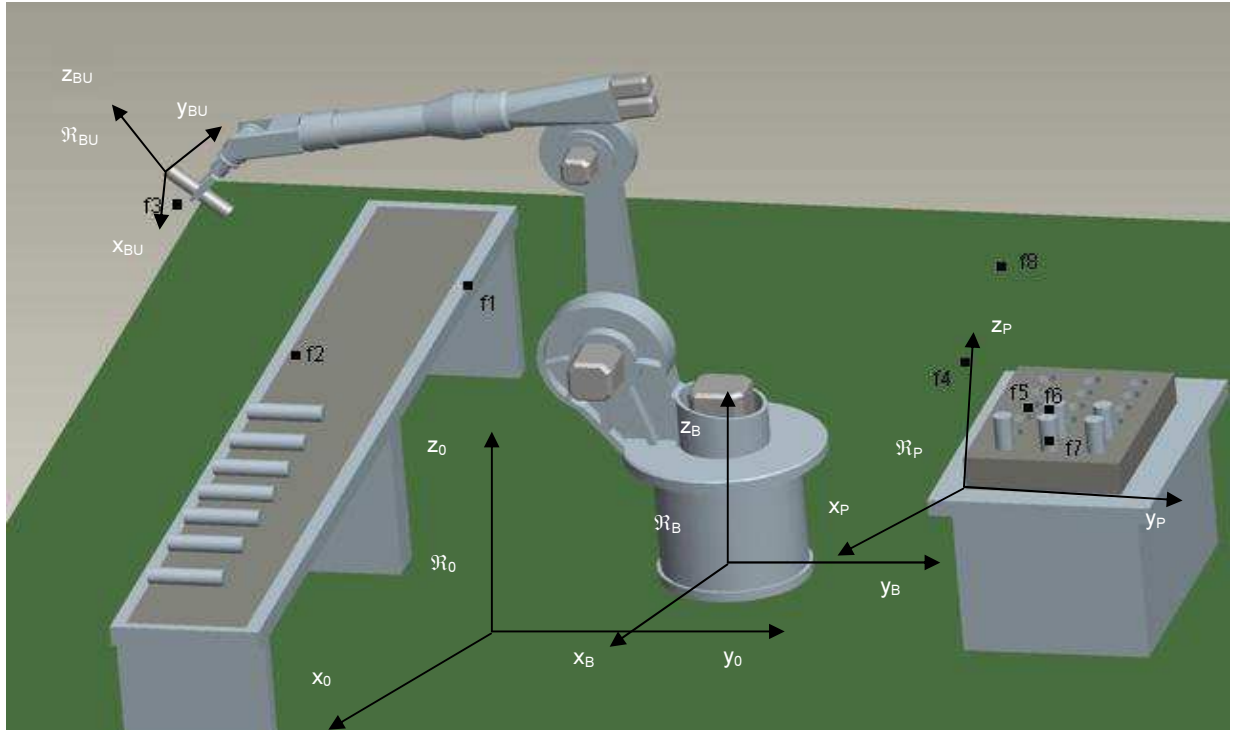
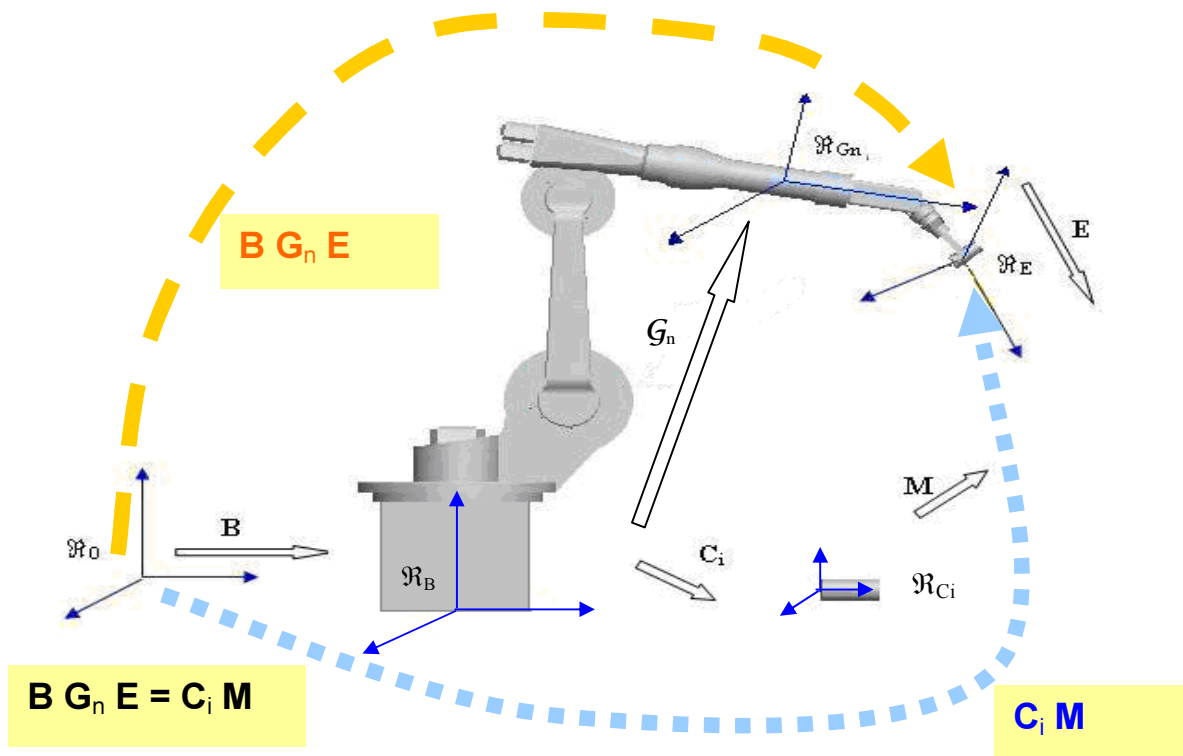
$$G_i \tau_{O_i} = [J_{G_i}]^{-1}]^T \cdot \tau_0$$

J_r – Jacobianul robotului
 J_{G_i} – Jacobianul sistemului atasat elementului i

4. Modelul dinamic al unui robot



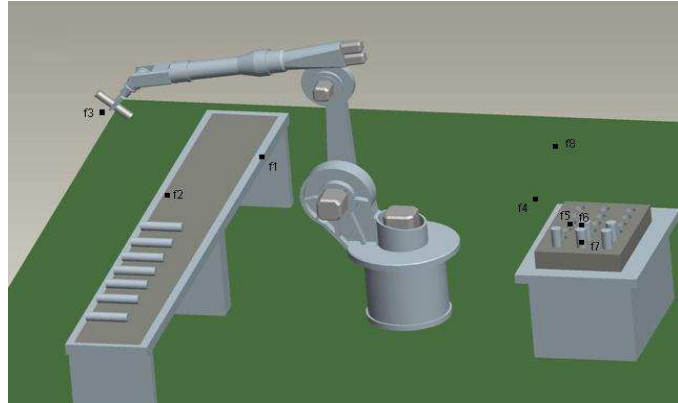
5. Structurarea sarcinii unui robot



$$f_1: [B][{}^0G_6][E] = [BU_i][AD]$$

$$f_2: [B][{}^0G_6][E] = [BU_i][PA]$$

Prinderea
bulonului



$$f_3: [B][{}^0G_6][E] = [BU_i][RV][PA]$$

$$f_4: [B][{}^0G_6][E] = [P][PG_i][TB][PA]$$

$$f_5: [B][{}^0G_6][E] = [P][PG_i][CP][PA]$$

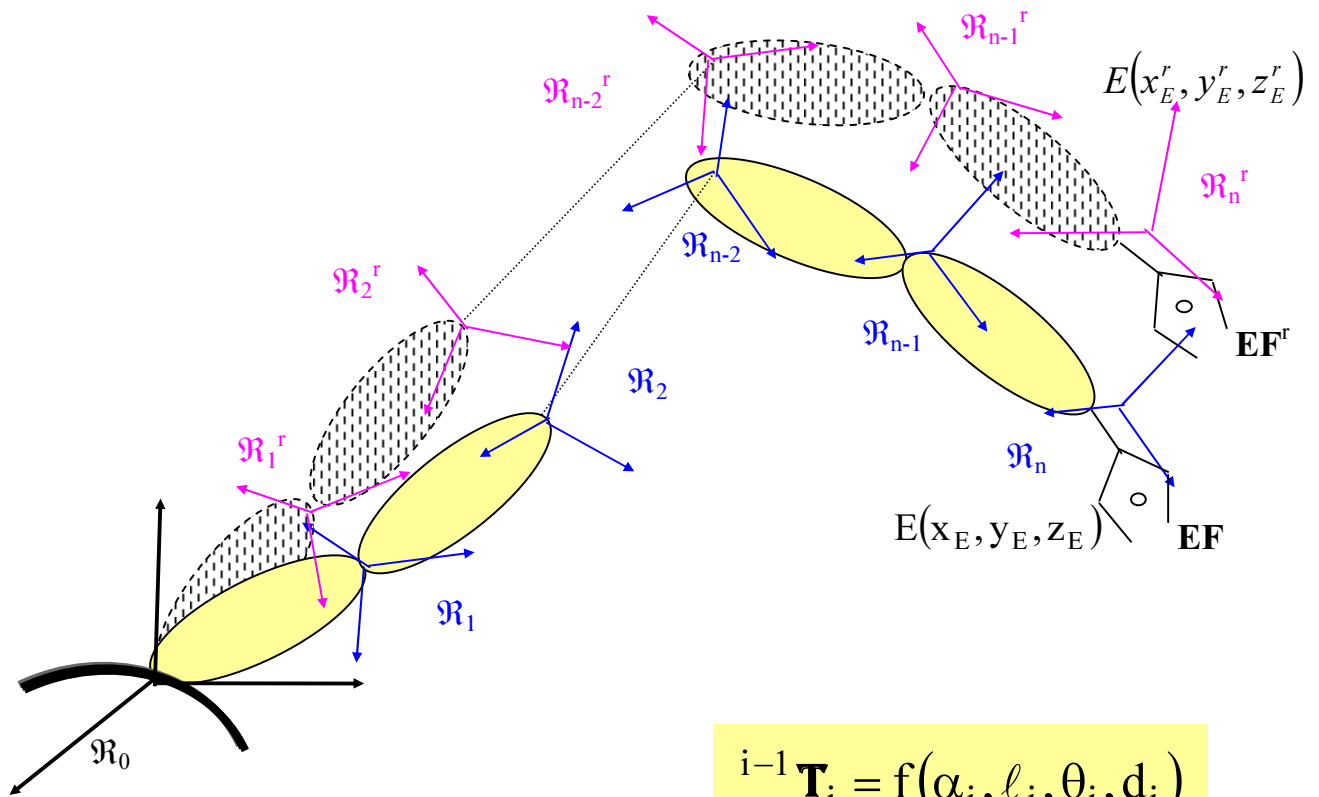
$$f_6: [B][{}^0G_6][E] = [P][PG_i][PV][PA]$$

$$f_7: [B][{}^0G_6][E] = [P][PG_i][FB][PA]$$

Eliberarea bulonului

$$f_8: {}^0B \cdot {}^B \mathbf{G}_n \cdot {}^{Gn}E = {}^0P \cdot {}^P PG_i \cdot {}^{PG_i}FB \cdot {}^{FB}AD$$

6. Corecții pentru poziția și orientarea efortorului final al unui robot



$${}^{i-1}\mathbf{T}_i = f(\alpha_i, l_i, \theta_i, d_i)$$

$$\alpha_i^r = \alpha_i + d\alpha_i$$

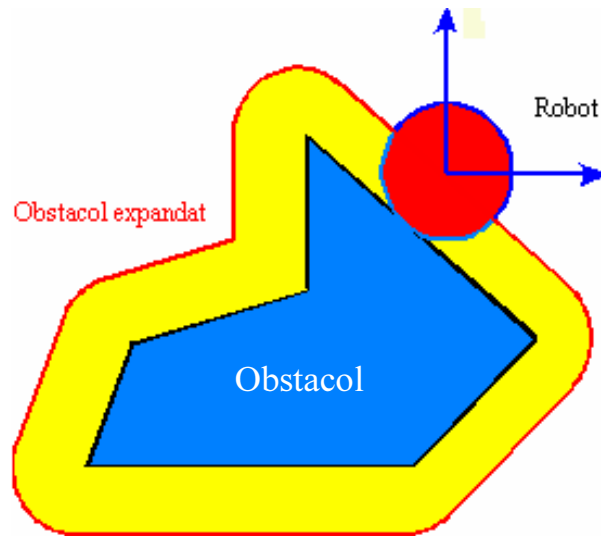
$$l_i^r = l_i + dl_i$$

$$\theta_i^r = \theta_i + d\theta_i$$

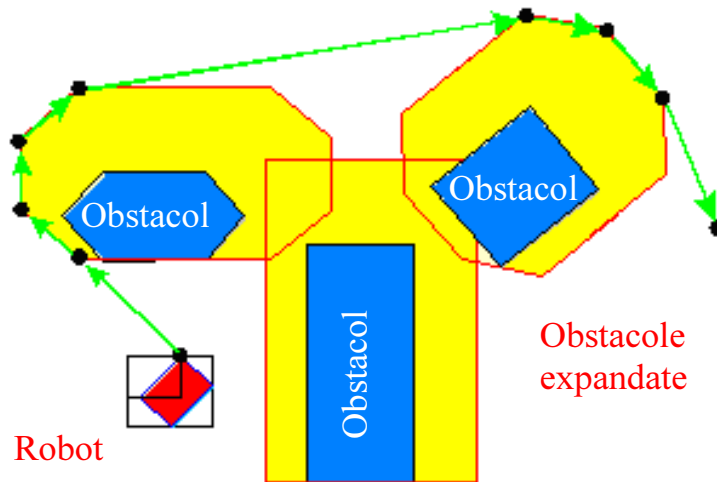
$$d_i^r = d_i + dd_i$$

$${}^{i-1}\mathbf{T}_i^r = f(\alpha_i^r, l_i^r, \theta_i^r, d_i^r) = f(\alpha_i + d\alpha_i, l_i + dl_i, \theta_i + d\theta_i, d_i + dd_i)$$

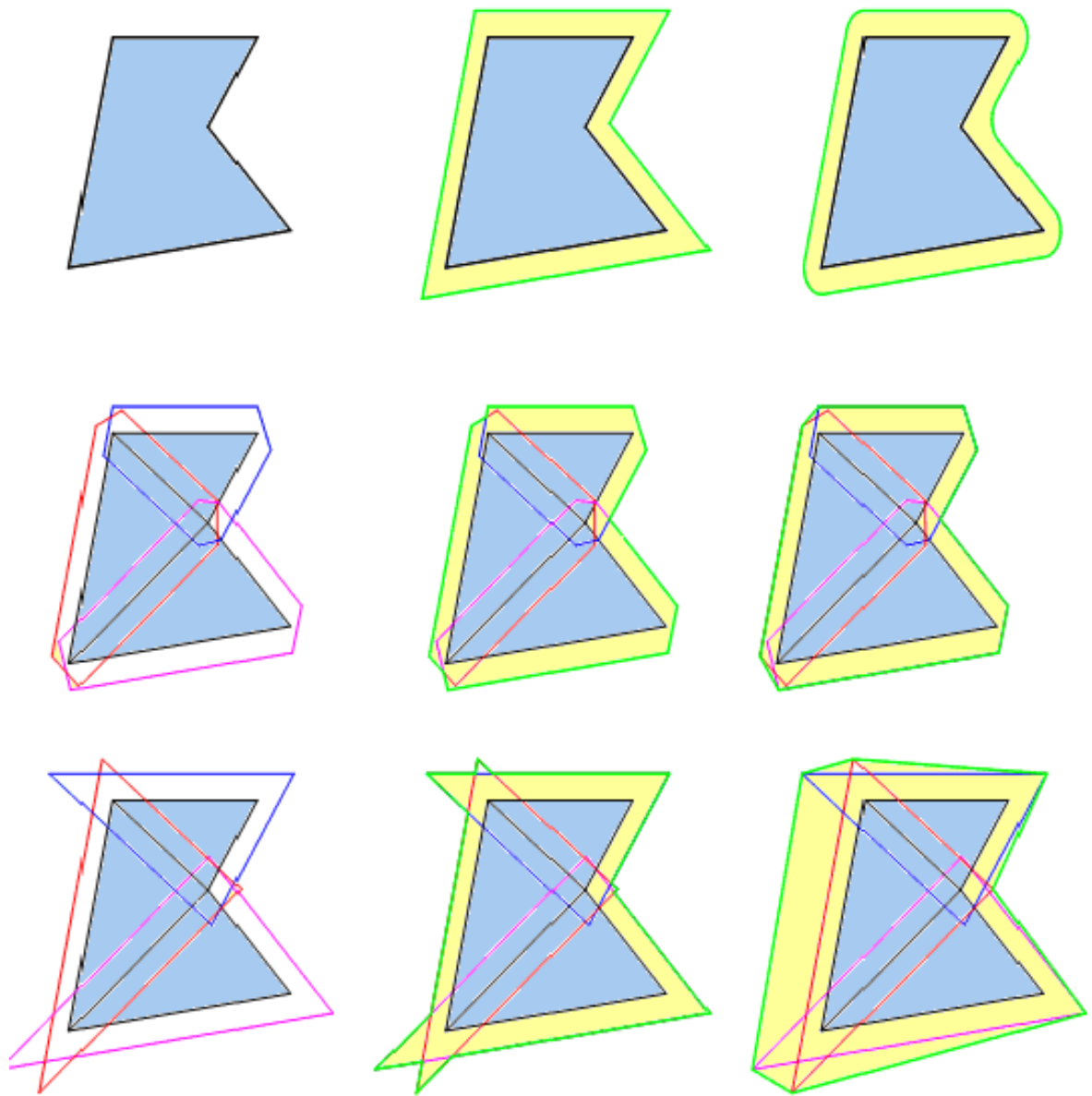
7. Expandarea obstacolelor



Obstacol expandat și robot modelat sub formă de disc

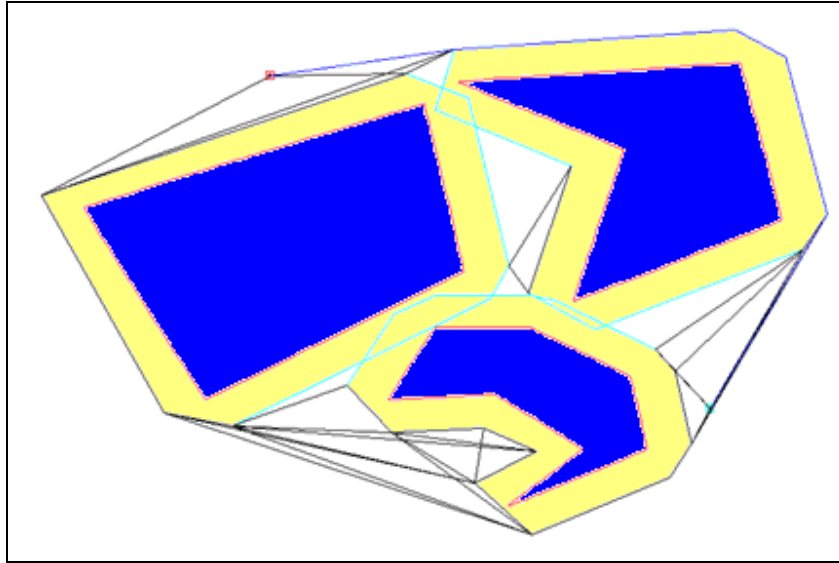


Obstacole expandate și robot punctiform

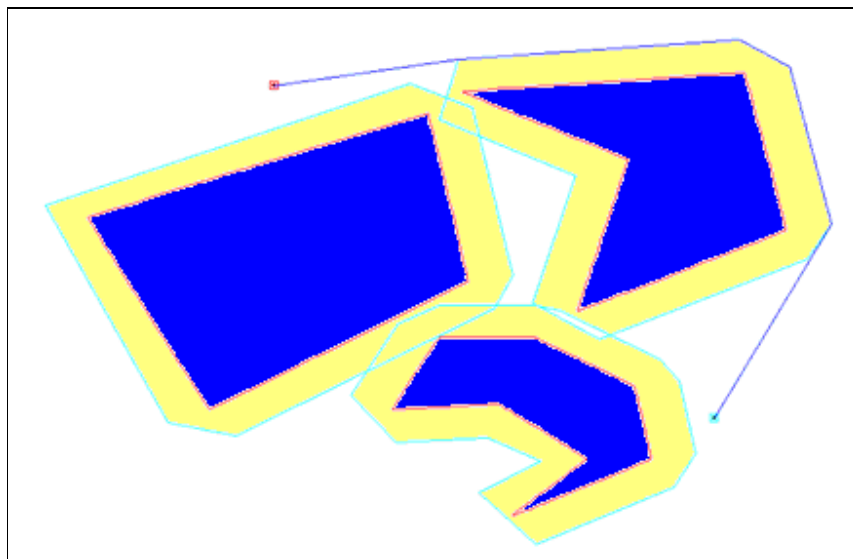


Obstacole expandate

8. Metoda grafului vizibilității



Graful vizibilitatii



Drumul minim

9. Metoda retractării

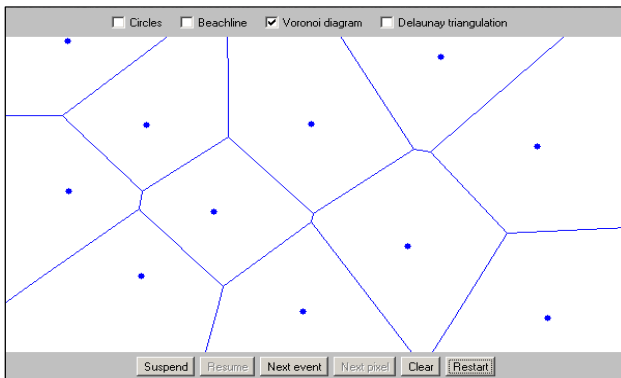
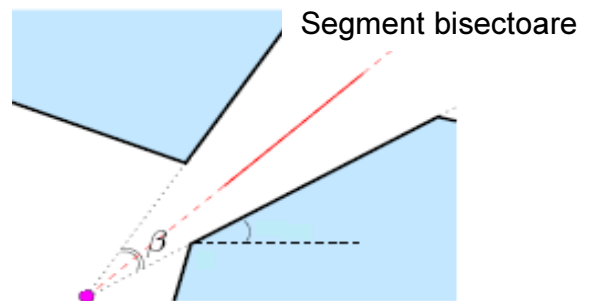
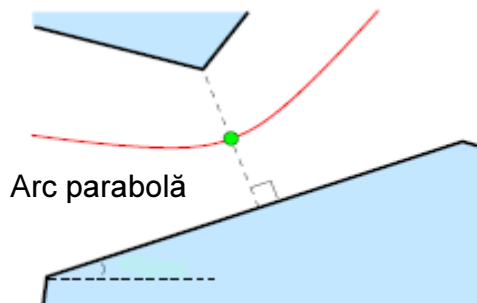
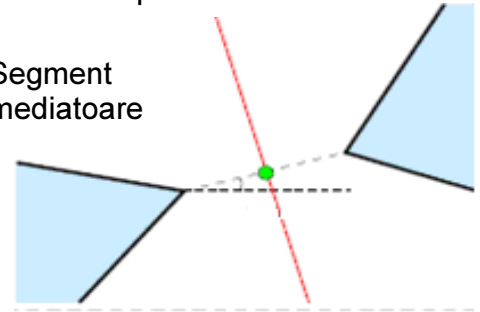
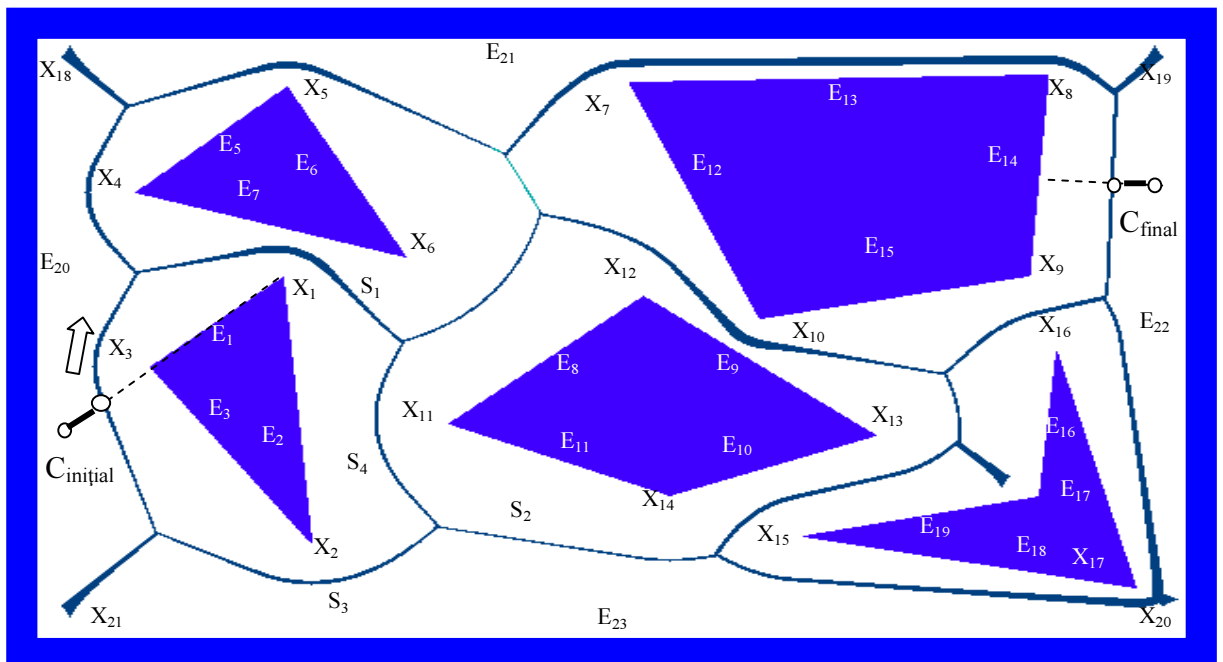


Diagrama Voronoi
pentru o mulțime finită
de puncte

Segment
mediatoare

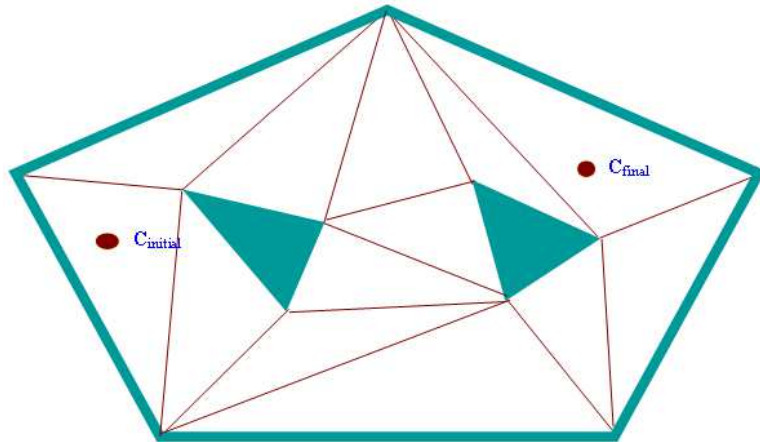


Elementele Diagramei Voronoi pentru obstacole modelate prin poligoane

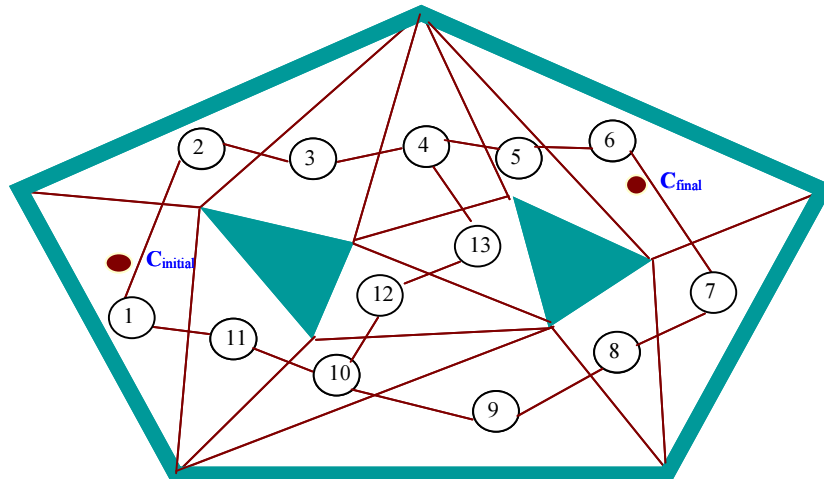


10. Metoda descompunerii poligonale

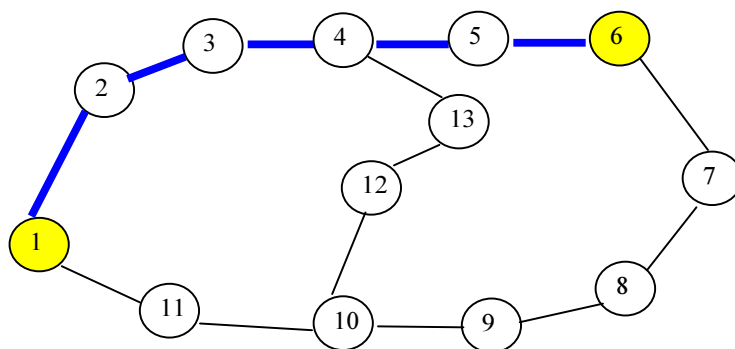
Descompunerea triunghiulară



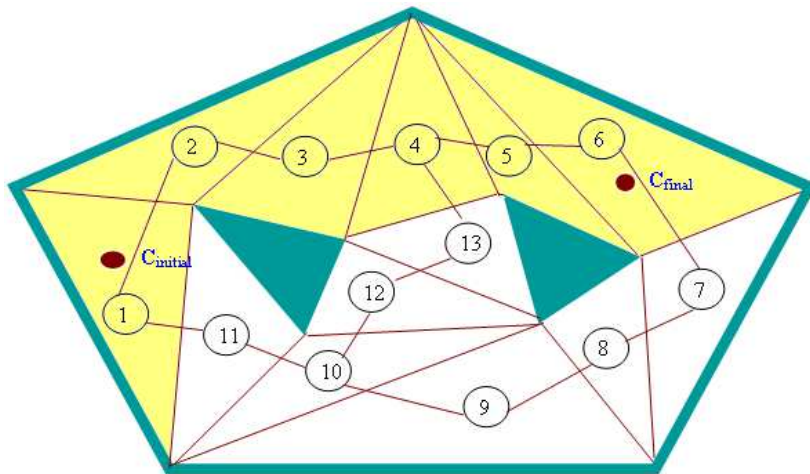
Descompunerea triunghiulară asociată spațiului de lucru



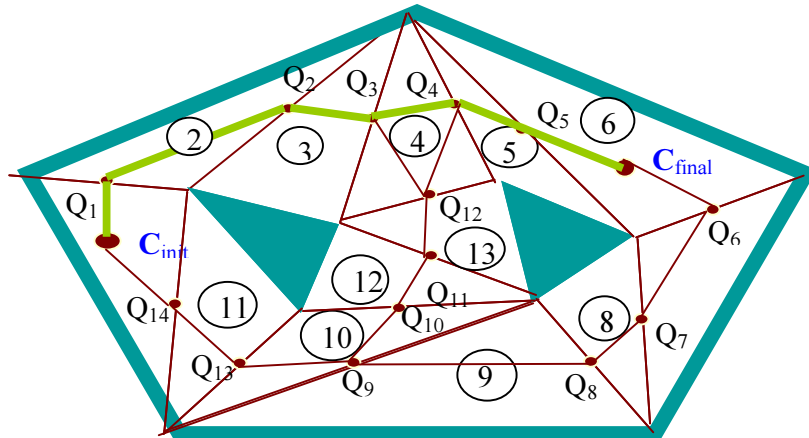
Etichetarea celulelor triunghiulare k_i



Graful de conexitate G asociat descompunerii K

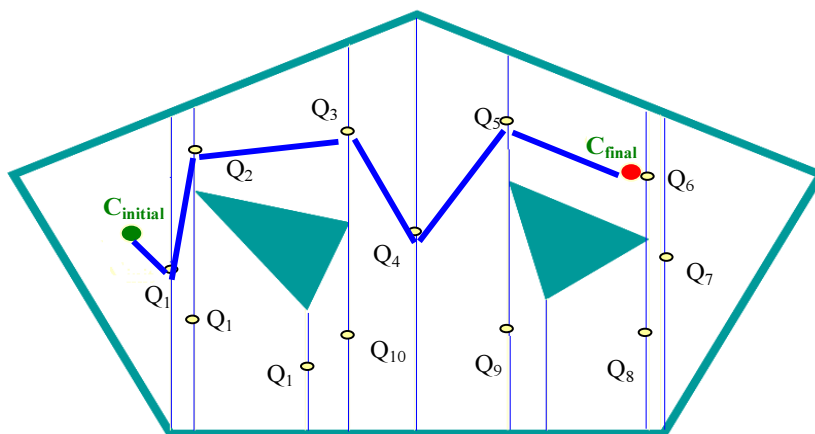


Cercetarea grafului G



Generarea drumului liber prin conectarea punctelor de mijloc Q_i

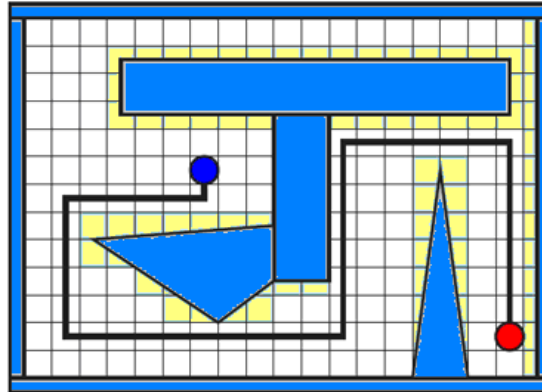
Descompunere trapezoidală



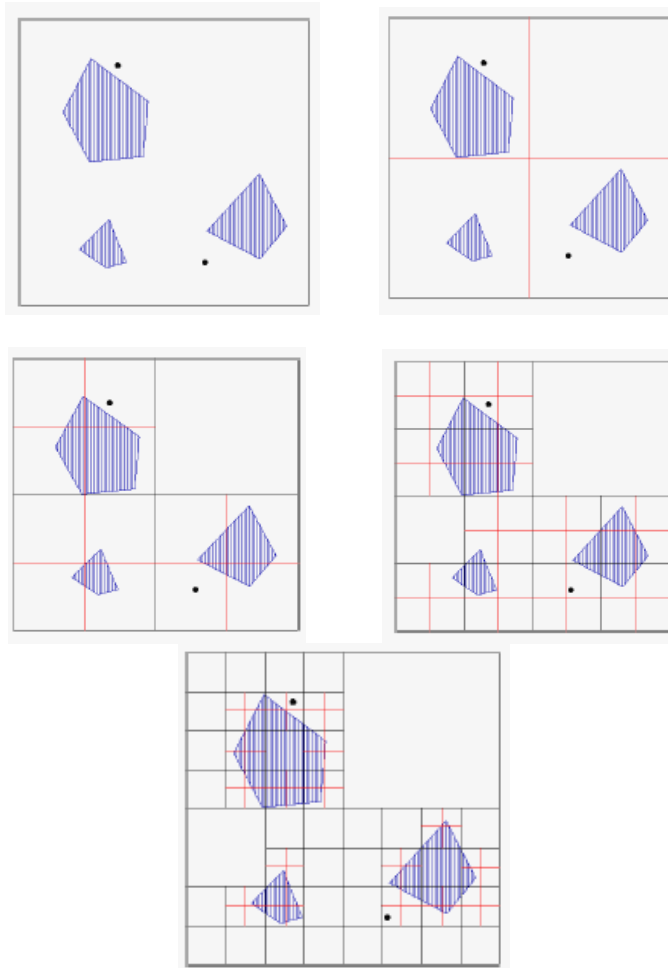
Descompunere trapezoidală

11. Descompunere celulara aproximativa

Descompunere omogena



Metoda arborelui



12. Metoda câmpului potențial

