

Alimentation électrique d'un TGV

1 Alimentation sans feeder

```
[6]: import numpy as np
rho=1.72e-8
s=1.47e-4
alpha=rho/s
d=60e3
E=25e3
I0=600
```

Le système est:
$$\begin{cases} U_1 + V_A = E \\ U_2 + V_A = E \\ \frac{U_1}{\alpha \cdot x} + \frac{U_2}{\alpha \cdot (d - x)} = I_0 \end{cases}$$

```
[7]: x=d/2
A=np.array([[1,0,1],[0,1,1],[1/(alpha*x),1/(alpha*(d-x)),0]])
B=np.array([E,E,I0])
```

```
[8]: print(np.linalg.solve(A,B))
```

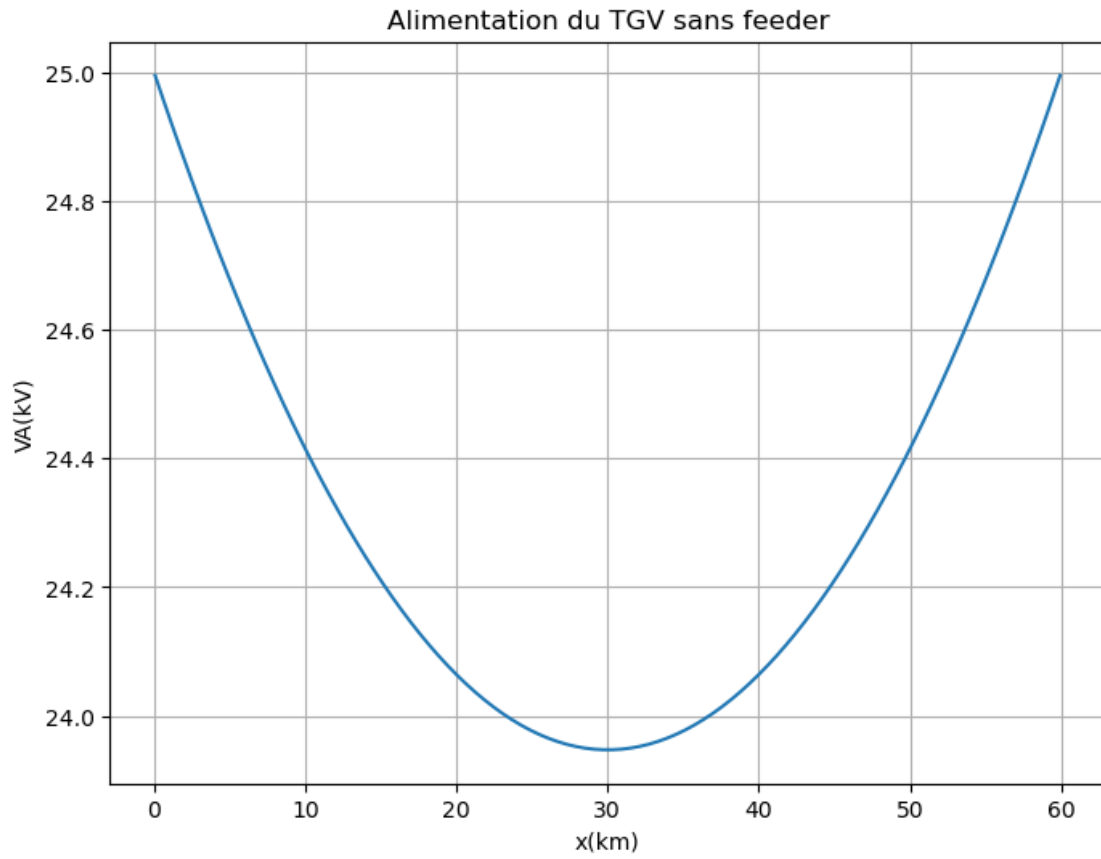
```
[ 1053.06122449  1053.06122449 23946.93877551]
```

Au milieu, la tension V_A vaut donc $23,9kV$.

```
[9]: N=100
tab_x=np.linspace(d*0.001,d*0.999,N)
tab_VA=np.zeros(N)
for i in range(N):
    x=tab_x[i]
    A=np.array([[1,0,1],[0,1,1],[1/(alpha*x),1/(alpha*(d-x)),0]])
    B=np.array([E,E,I0])
    tab_VA[i]=np.linalg.solve(A,B)[2]
```

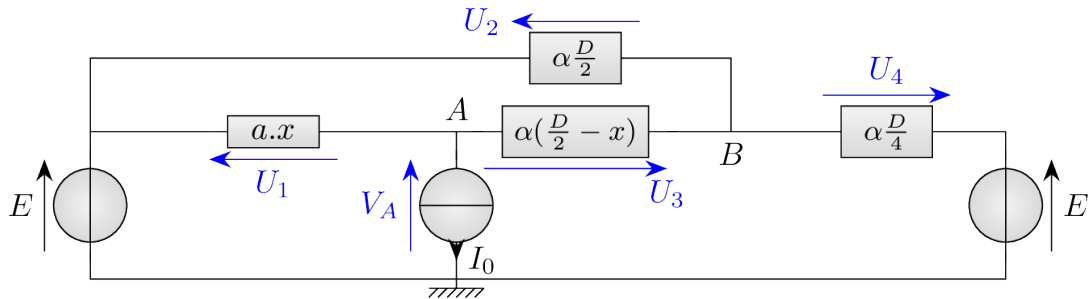
```
[10]: import matplotlib.pyplot as plt
plt.figure(figsize=(8,6))
plt.plot(tab_x/1000,tab_VA/1000)
plt.xlabel("x(km)")
plt.ylabel("VA(kV)")
```

```
plt.title("Alimentation du TGV sans feeder")
plt.grid()
plt.show()
```



2 Alimentation avec feeder

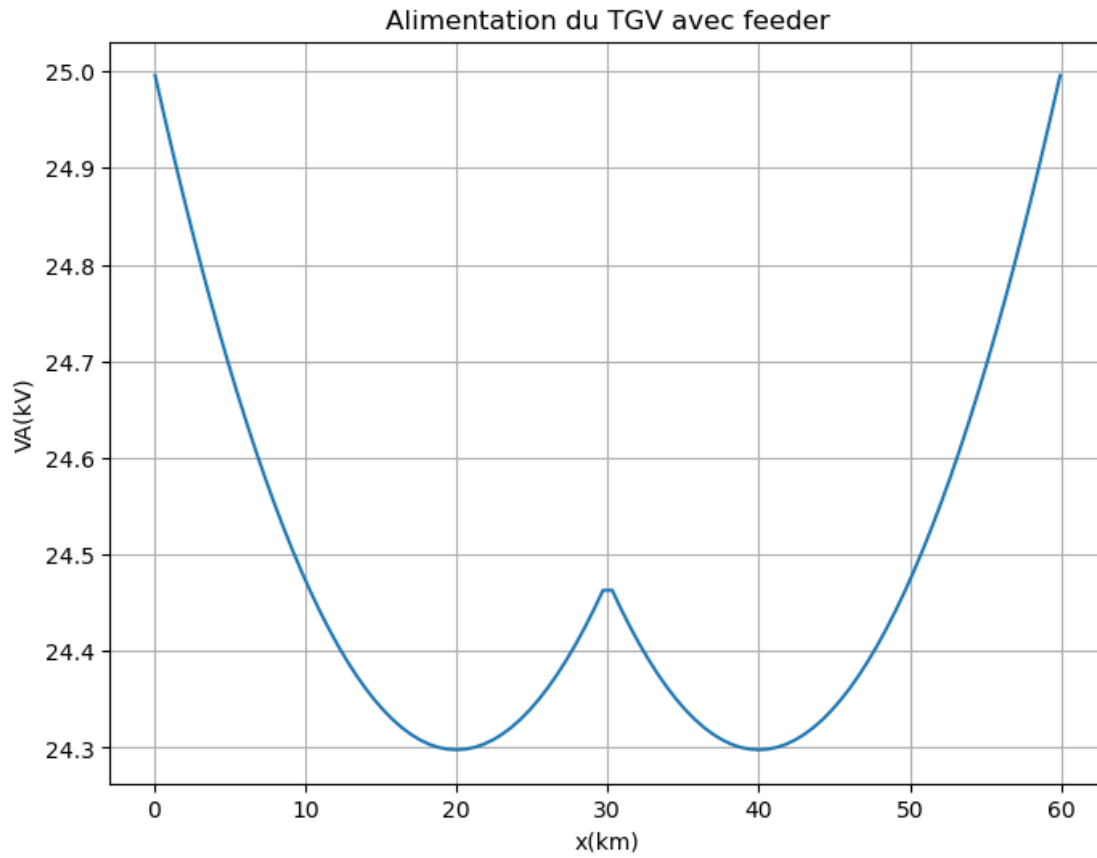
On commence par associer deux résistances.



On obtient le système:
$$\begin{cases} U_1 + V_A = E \\ U_3 + U_4 + V_A = E \\ U_1 - U_2 - U_3 = 0 \\ \frac{U_1}{\alpha \cdot x} + \frac{U_3}{\alpha \cdot (\frac{d}{2} - x)} = I_0 \\ \frac{U_2}{\alpha \frac{d}{2}} - \frac{U_3}{\alpha \cdot (\frac{d}{2} - x)} + \frac{U_4}{\alpha \cdot \frac{d}{4}} = 0 \end{cases}$$

```
[11]: import numpy as np
rho=1.72e-8
s=1.47e-4
alpha=rho/s
d=60e3
E=25e3
I0=600
N=100
tab_x=np.linspace(d*0.001,d*0.999,N)
tab_VA2=np.zeros(N)
for i in range(N//2):
    x=tab_x[i]
    A=np.array([[1,0,0,0,1],[0,0,1,1,1],[1,-1,-1,0,0],[1/(alpha*x),0,1/
↪(alpha*(d/2-x)),0,0],[0,2/(alpha*d),-1/(alpha*(d/2-x)),4/(alpha*d),0]])
    B=np.array([E,E,0,I0,0])
    tab_VA2[i]=np.linalg.solve(A,B)[4]
    tab_VA2[N-1-i]=tab_VA2[i]
```

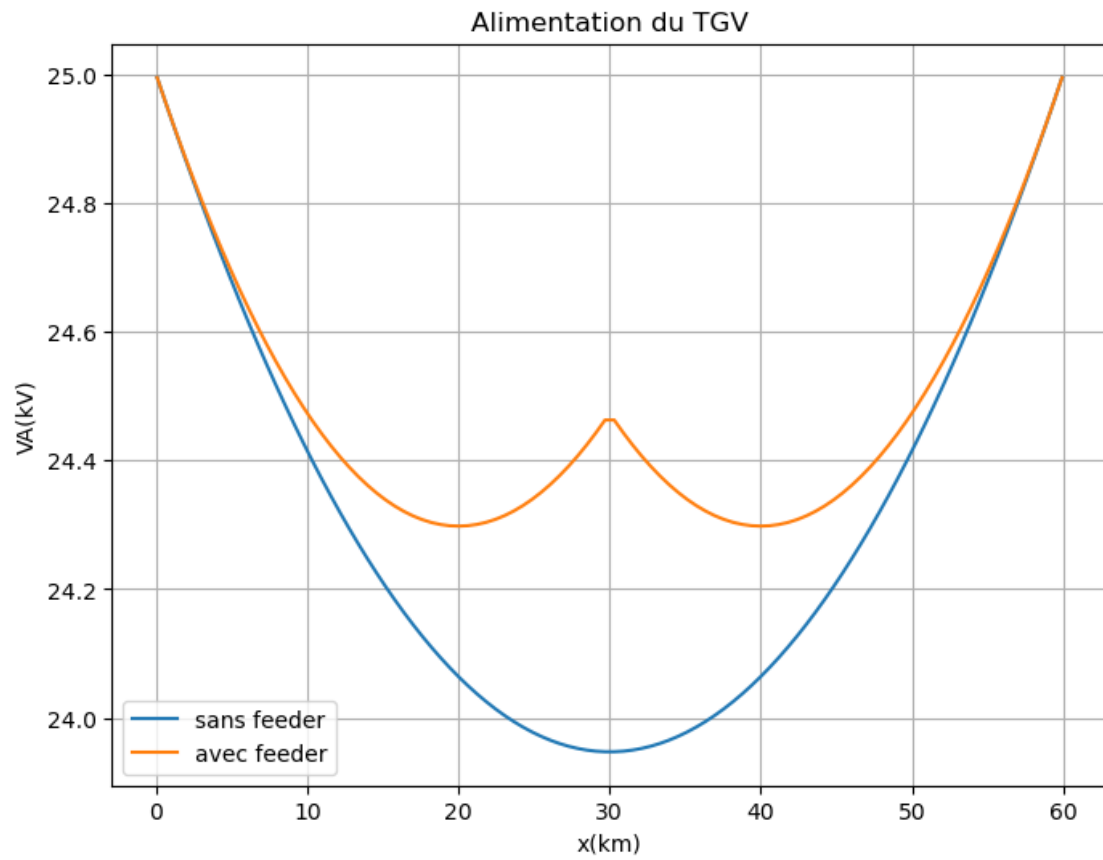
```
[12]: import matplotlib.pyplot as plt
plt.figure(figsize=(8,6))
plt.plot(tab_x/1000,tab_VA2/1000)
plt.xlabel("x(km)")
plt.ylabel("VA(kV)")
plt.title("Alimentation du TGV avec feeder")
plt.grid()
plt.show()
```



On ne descend plus qu'à 24,3kV

On peut superposer les courbes:

```
[13]: import matplotlib.pyplot as plt
plt.figure(figsize=(8,6))
plt.plot(tab_x/1000,tab_VA/1000,label="sans feeder")
plt.plot(tab_x/1000,tab_VA2/1000,label="avec feeder")
plt.xlabel("x(km)")
plt.ylabel("VA(kV)")
plt.title("Alimentation du TGV")
plt.grid()
plt.legend()
plt.show()
```



[]: