simple laws of motion: 3-step and cycloidal

three-step

$\lambda_1 = \Delta t_1 / T$

$\lambda_3 = \Delta t_3 / T$

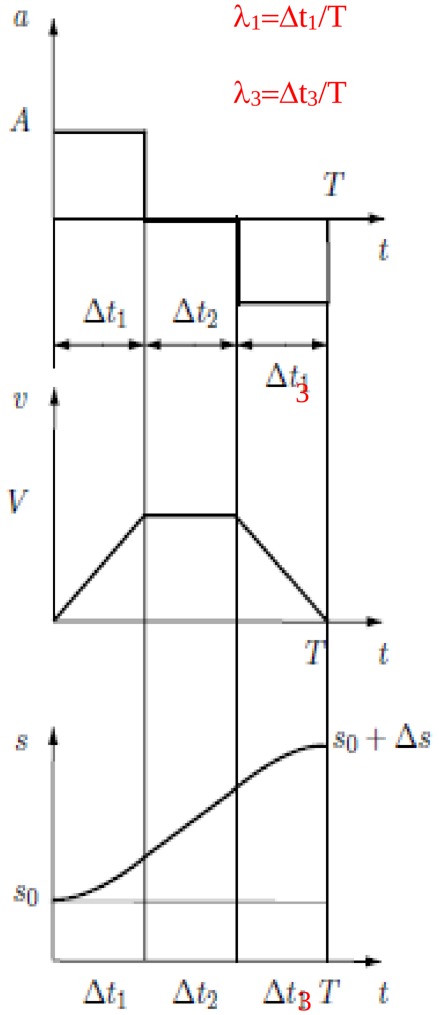


Figura 9.3 Legge di moto ad accelerazione costante simmetrica; per le relazioni analitiche vedi figura 9.5.

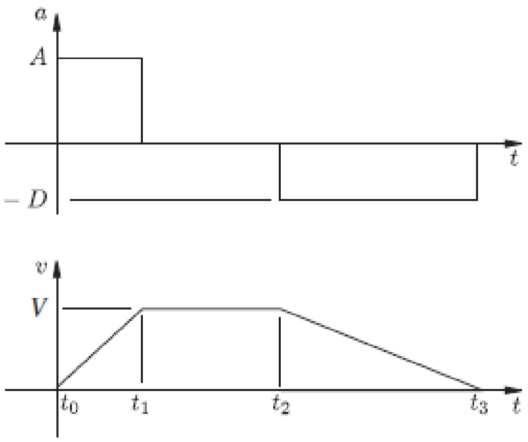
use of matlab function

```
function [x,xp,xpp]=tretratti(t,T,S0,dS,l1,l3)
%
% t time
% T total motion time
% S0 initial position
% dS displacement (Sfinal=S0+dS)
% l1 lambda1 (relative duration of first segment)
% l3 lambda3 (relative duration of third segment)
```

Example of use

```
T = 5 % motion time in seconds
n = 100 % n. of points of the law
dT = T/(n-1) % time step
xi = 5 % initial value
xf = 15 % final value
dx = xf-xi % displacement
l1 = 0.333 % percentage of motion time (1st step) 0.2=20%
l3 = 0.333 % percentage of motion time (3rd step) 0.2=20%

for i=1:n
    t=(i-1)*T/(n-1); % time from 0 to T with step dT
    tt(i)=t;
    [x(i),v(i),a(i)]=tretratti(t,T,xi,dx,l1,l3); position,
velocity, acceleration
end
```

t	a	v	s
t_0, t_1	A	$A(t-t_0)$	$\dfrac{A(t-t_0)^2}{2} + s_0$
t_1, t_2	0	V	$\dfrac{A(t_1-t_0)^2}{2} + V(t-t_1) + s_0$
t_2, t_3	$-D$	$D(t_3-t)$	$\Delta s - \dfrac{D(t_3-t)^2}{2} + s_0$

$V = \Delta S/((t_1-t_0)/2 + (t_2-t_1) + (t_3-t_2)/2)$

$A = V/(t_0 - t_1) \qquad D = V/(t_3 - t_2)$

Figura 9.5 Legge di moto ad accelerazione costante con accelerazione positiva $A = a^+$ diversa da quella negativa $D = a^-$.

cycloidal

$$
\begin{aligned}
\ddot{s} &= \frac{\Delta s}{T^2} 2\pi \sin\left(2\pi \frac{t}{T}\right) \\
\dot{s} &= \frac{\Delta s}{T}\left(1 - \cos\left(2\pi \frac{t}{T}\right)\right) \\
s &= \Delta s \left(\frac{t}{T} - \frac{1}{2\pi} \sin\left(2\pi \frac{t}{T}\right)\right) + s_0
\end{aligned}
$$

$$
\begin{aligned}
v_{max} &= 2\frac{\Delta s}{T} & C_v &= 2 \\
a_{max} &= 2\pi \frac{\Delta s}{T^2} & C_a &= 2\pi \\
p_{max} &= \frac{3}{2}\pi\sqrt{3}\, m \,\frac{\Delta s^2}{T^3} & C_p &= \frac{3}{2}\pi\sqrt{3}
\end{aligned}
$$

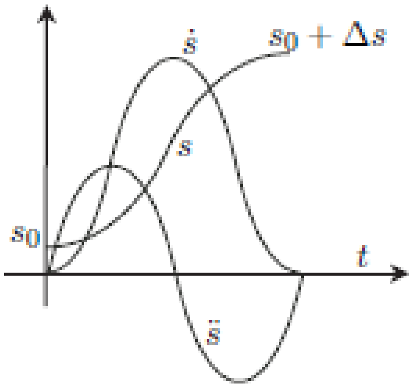


Figura 9.4 Legge di moto cicloidale.