Sistema ad anello chiuso PI

$tau := 12 \qquad Ao := 1 \qquad t := 0, 0.1 .. 100$

$Gf(s) := \frac{Ao}{1 + s \cdot tau} \qquad E(s) := \frac{1}{s}$ (Gradino)

$Kp1 := 1 \qquad Ti1 := \frac{1}{10} \qquad Gc1(s) := Kp1 \cdot \left(1 + \frac{1}{Ti1 \cdot s}\right) \qquad G1(s) := \frac{Gc1(s) \cdot Gf(s)}{1 + Gc1(s) \cdot Gf(s)} \text{ simplify } \rightarrow \frac{s + 10}{2 \cdot \left(6 \cdot s^2 + s + 5\right)}$

$U1(s) := E(s) \cdot G1(s) \qquad U1(t) := U1(s) \text{ invlaplace } \rightarrow 1 - e^{-\frac{t}{12}} \cdot \cos\left(\frac{\sqrt{119} \cdot t}{12}\right)$

$Kp2 := 1 \qquad Ti2 := 3 \qquad Gc2(s) := Kp2 \cdot \left(1 + \frac{1}{Ti2 \cdot s}\right) \qquad G2(s) := \frac{Gc2(s) \cdot Gf(s)}{1 + Gc2(s) \cdot Gf(s)} \text{ simplify } \rightarrow \frac{3 \cdot s + 1}{36 \cdot s^2 + 6 \cdot s + 1}$

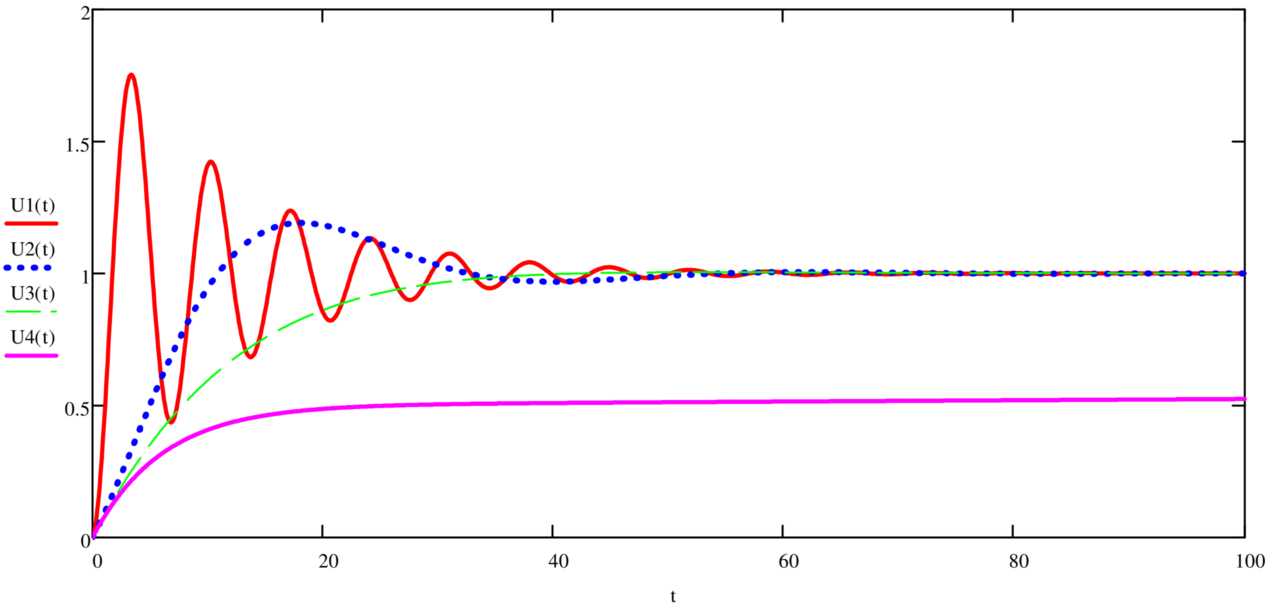
$U2(s) := E(s) \cdot G2(s) \qquad U2(t) := U2(s) \text{ invlaplace } \rightarrow 1 - e^{-\frac{t}{12}} \cdot \cos\left(\frac{\sqrt{3} \cdot t}{12}\right)$

$Kp3 := 1 \qquad Ti3 := 10 \qquad Gc3(s) := Kp3 \cdot \left(1 + \frac{1}{Ti3 \cdot s}\right) \qquad G3(s) := \frac{Gc3(s) \cdot Gf(s)}{1 + Gc3(s) \cdot Gf(s)} \text{ simplify } \rightarrow \frac{10 \cdot s + 1}{120 \cdot s^2 + 20 \cdot s + 1}$

$U3(s) := E(s) \cdot G3(s) \qquad U3(t) := U3(s) \text{ invlaplace } \rightarrow 1 - e^{-\frac{t}{12}} \cdot \cos\left(\frac{\sqrt{5} \cdot t}{60}\right)$

$Kp4 := 1 \qquad Ti4 := 1000 \qquad Gc4(s) := Kp4 \cdot \left(1 + \frac{1}{Ti4 \cdot s}\right) \qquad G4(s) := \frac{Gc4(s) \cdot Gf(s)}{1 + Gc4(s) \cdot Gf(s)} \text{ simplify } \rightarrow \frac{1000 \cdot s + 1}{12000 \cdot s^2 + 2000 \cdot s + 1}$

$U4(s) := E(s) \cdot G4(s) \qquad U4(t) := U4(s) \text{ invlaplace } \rightarrow 1 - e^{-\frac{t}{12}} \cdot \cosh\left(\frac{\sqrt{10} \cdot \sqrt{247} \cdot t}{600}\right)$



L'offset è presente quando si opera solo con il controllore proporzionale (Ti --> infinito) sparisce attivando il termine integrale.
Riducendo Ti il sistema risponde più velocemente al transitorio, ma si osservano anche delle forti oscillazioni.