Q&A

Question: Can KSS calculate the Forward efficiency or Backward efficiency?

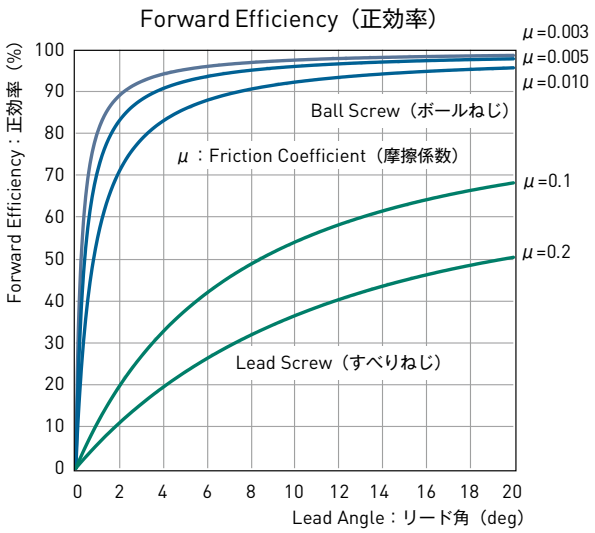
Forward/Backward efficiency is the ratio of Input and Output. In case of Ball Screws, it is defined as ratio of theoretical Torque and actual Torque.

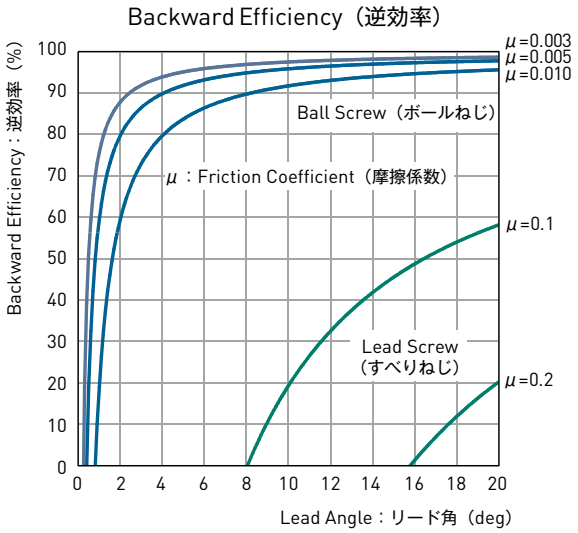
Forward efficiency : $\eta_p = (\sin\theta - \mu_1 \cdot \tan\beta) \,/\, (\sin\theta + \mu_1 \,/\, \tan\beta) \times 100\ (\%)$
Backward efficiency : $\eta_n = (\sin\theta - \mu_2 \,/\, \tan\beta) \,/\, (\sin\theta + \mu_2 \cdot \tan\beta) \times 100\ (\%)$

μ_1 : Forward friction coefficient (0.003 ~ 0.005)
μ_2 : Backward friction coefficient (0.005 ~ 0.010)
θ : Contact angle of Ball Screw groove (45°)

$\tan\beta = \ell \,/\, (\pi \cdot BCD)$
β : Lead angle
ℓ : Lead (mm)
BCD : Ball center diameter (mm)

As you can see the formula above, Efficiency has much to do with Lead angle. Graphs below show the Forward/Backward Efficiency against Lead angle.





Forward/Backward Torque Forward/Backward resistance are calculated by following formula based on Forward/Backward Efficiency.

$Ta = Fa \cdot \ell \,/\, (2\pi\eta_p)$
$Tb = Fb \cdot \ell \cdot \eta_n \,/\, (2\pi)$

Therefore

Forward resistance $Fa = (2\pi\eta_p \,/\, \ell) \times Ta$
Backward resistance $Fb = 2\pi \,/\, (\ell \cdot \eta_n) \times Tb$

Ta : Forward Torque (Nm)
Tb : Backward Torque (Nm)
Fa,b : Axial load (N) ……Resistance
ℓ : Lead (m)
η_p : Forward efficiency
η_n : Backward efficiency

It is clear that friction resistance of Ball Screw is extremely small!!!