Nonlinear Equations

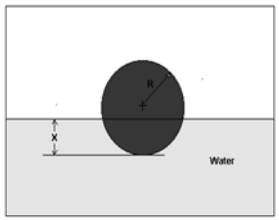
Your nonlinearity confuses me

$$ax^5 + bx^4 + cx^3 + dx^2 + ex + f = 0$$

$$\tanh(x) = x$$

Example – General Engineering

You are working for 'DOWN THE TOILET COMPANY' that makes floats for ABC commodes. The floating ball has a specific gravity of 0.6 and has a radius of 5.5 cm. You are asked to find the depth to which the ball is submerged when floating in water.



$$x^3 - 0.165x^2 + 3.993\times10^{-4} = 0$$

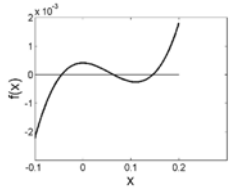


Figure: Diagram of the floating ball

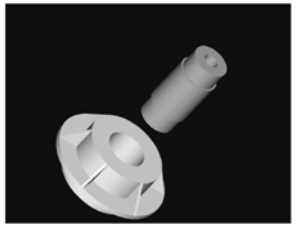
For the trunnion-hub problem discussed on first day of class where we were seeking contraction of 0.015″, did the trunnion shrink enough when dipped in dry-ice/alcohol mixture?

1. Yes
2. No

Example – Mechanical Engineering

Since the answer was a resounding NO, a logical question to ask would be:

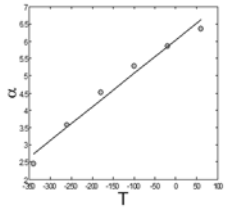
If the temperature of -108°F is not enough for the contraction, what is?



Finding The Temperature of the Fluid

$$\Delta D = D\int_{T_a}^{T_c} \alpha(T)dT$$

$T_a = 80^oF$
$T_c = ???^oF$
$D = 12.363"$
$\Delta D = -0.015"$



$$\alpha(T) = 6.033 + 0.009696\,T$$

$$-0.015 = 5.992\times10^{-8}T_c^2 + 7.457\times10^{-5}T_c - 6.349\times10^{-3}$$

$$f(T_c) = 5.992\times10^{-8}T_c^2 + 7.457\times10^{-5}T_c + 8.651\times10^{-3} = 0$$

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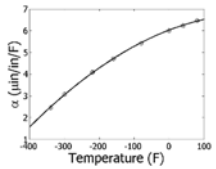

$$\alpha = -1.228\times10^{-5}T^2 + 6.195\times10^{-3}T + 6.015$$

$$-0.015 = -5.059\times10^{-9}T_c^3 + 3.829\times10^{-6}T_c^2 + 7.435\times10^{-5}T_c - 6.166\times10^{-3}$$

$$f(T_c) = -5.059\times10^{-9}T_c^3 + 3.829\times10^{-6}T_c^2 + 7.435\times10^{-5}T_c + 8.834\times10^{-3} = 0$$