Table of Equations for SCP Actuators

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1 Variable Names and Description

Variables		
Variable Name	Units	Description
k	N/m	Spring constant; provided in literature based off of material used
d	m	Movement; change in actuator length when load and heat are applied or change in position of load when actuator contracts
T	K	Temperature of the Actuator
T_0	K	Ambient Temperature
c	W/mK	Thermal Constant
P	W	Power
$P_{dissociated}$	W	Power dissipated as heat or friction
V	V	Voltage
R	Ω	Resistance
ρ	Ωm	Resistivity; provided in the literature and dependent on type of string used
l	m	Length of the actuator (coiled)
$l_{original}$	m	Length of string used to make actuator
A	m^2	Area; based on diameter of actuator
Δt	N/A	Coil deformation due to change in fiber twist per initial fiber length
LCL	N/A	Length contraction factor (ratio of non-twisted fiber length ($l_{original}$) to coil length (l); used from literature characterization of the actuators
N	N/A	Number of coil turns; (turns/m)*$l_{original}$

1.1 Length Contraction Factor and Turns/m for Each Type of Thread

LCL and Turns/m		
LCL	Turns/m	Type of Thread
4.5	3020	127 μm nylon 6,6 monofilament
4.2	2430	180 μm silve plated nylon 6,6 multifilament
4.5	1430	270 μm nylon 6 monofilament
3.3	2270	130 μm fused polyethelene braid

2 Equations

$$F = kd + c(T - T_0) \tag{1}$$

$$cP = P_{dissociated}(T, T_0) \tag{2}$$

$$P = \frac{V^2}{R} \tag{3}$$

$$R = \rho * l \tag{4}$$

$$I = \frac{V}{R} \tag{5}$$

$$l = \frac{l_{original}}{LCL} \tag{6}$$

$$\frac{d}{l} = \frac{l_{original} * \Delta t}{l * N} \tag{7}$$