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NOMENCLATURE

A_c	cross section area of fin, m^2
b	spacing between two fins, m
c_1, c_2	acceleration parameter (for PSO algorithm)
constant	Penalty constant
C_p	specific heat , J/kg K
EI	Elenbaas number
g	acceleration of gravity, m/s^2
g_i	constraint
H	height of fin, m
h	heat transfer coefficient, W/m^2 K
K	thermal conductivity of heat sink, W/m K
K_a	thermal conductivity of air, W/m K
L	heat sink length, m
m	fin parameter $\approx \sqrt{hP / K_a A_c}$, m^{-1}
n	fin number
P	cross section circumference of the fin, m
px	particle's position (for PSO algorithm)
Q	heat load, W
R_{base}	the thermal resistance of the bulk material, K/W
R_{sink}	the overall thermal resistance of the heat sink, K/W
R_{total}	the overall thermal resistance of fins, K/W
R_{fin}	thermal resistance of each fin, K/W
$\dot{S}_{gen}$	entropy generation rate, W/ K
T_1	base temperature, K
T_2	ambient temperature, K
t	thickness of fin, m
t_b	base plate thickness, m
v	particle velocity (for PSO algorithm)
w	inertia weight (for PSO algorithm)
W	width of the plate-fin, m
x_i	design variables

Greek letters

β	thermal expansion coefficient
ρ	density of air, kg/m^3
η	fin efficiency
$\overline{\theta}$	average temperature difference between heat sink and ambient air, k
θ_b	temperature excess of the heat sink base plate, k

Subscripts

a	air
b	base plate
fin	single fin
i	particle index(for PSO algorithm)
gen	generation
max	maximum
min	minimum
sink	heat sink