TABLES OF CONTENTS

目錄

符號索引(Nomenclature)：照英文順序排列

a :
A :
b :
B :
c :
C :
.
.
Z :

希臘字母(Greek Symbols)：照希臘字母順序排列

α (Α):

β (Β):

γ (Γ):

δ (Δ):

ζ (Ζ):

η (Η):

θ (Θ):

ι (Ι):

κ (Κ):

λ (Λ):

μ (Μ):

ν (Ν):

ξ (Ξ):

o (Ο):

π (Π):

ρ (Ρ);

σ (Σ):

τ (Τ):

υ (ϒ):

φ (Ψ):

ω (Ω):

上標(superscripts)

* :

下標(subscripts)

∞ ：

Nomenclature

c specific heat (J/kg °C)

k thermal conductivity (W/m °C)

Q absorbed power deposition density (W/cm^3)

r distance along r-axis (mm)

r_0 radius of the blood vessel (mm)

r_1 radius of the heating tumor tissue (mm)

R dimensionless radius, $R = r/r_0$

t time (s)

T temperature (°C)

T_a arterial temperature = 37(°C)

w averaged blood velocity along z-direction (mm/s)

W_b blood perfusion rate (kg/m^3·s)

z distance along z-axis (mm)

Z dimensionless distance, $Z = z/r_0$

θ dimensionless temperature, $\theta = \dfrac{T - T_a}{T_a}$

ρ density (kg/m^3)

τ dimensionless time, $\tau = \dfrac{k_t t}{\rho_t c_t r_0^{\ 2}}$

Subscripts

b blood

t tissue

附帶說明 ： 作者的寫法

Chen[5] 僅有陳姓這位作者的寫法

Chen and Lai[17] 陳姓與賴姓兩位作者的寫法

Chen et al.[8] 陳姓與其他所有作者,共有三位以上作者的寫法

The primary aim of this study is to examine the effect of thermally significant blood vessel by introducing the energy transport equation of the blood flow. Deng and Liu [5] studied analytical solution to the bio-heat transfer problems with spatial or transient heating on skin surface or inside biological bodies using Green's function method. Without considering the blood vessel effect, their solutions were applied to several selected typical bio-heat transfer processes, which are often encountered in cancer hyperthermia, laser surgery, and tissue thermal parameter estimation. Chato [6] investigated heat transfer to blood vessels in three configurations including a single vessel, two vessels in counter flow, and a single vessel near the skin surface.

However the heating deposition power in tissue and the axial conduction in blood flow and tissue are not considered. Furthermore, Huang *et al.* [7] discussed the two cases (a) the average axially varying temperature of the blood and (b) the temperatures in its surrounding tissue, and obtained the analytical solutions. And their studies are restricted to a simple geometry and without considering the variation due to axially temperature gradient in tissue. There is little information concerning the effect of thermally significant large blood vessel on the temperature distribution and thermal lesion. Therefore, this study investigates the effects of thermally significant blood vessel with different diameters and velocities on thermal distributions within the heated tumor volume.

附帶說明：Equation、Table、 Figure 的寫法

Equation (1) 或 Eq.(1)

Equations (2) and (3) 或 Eqs.(2) and (3)

Equations (4) to (6) 或 Eqs. (4) to (6)

Table, Figure 或 Equation 出現在句首不得簡寫

例如 : Equation (1) shows.........

.........................in Eq.(2)

The energy equations of tissue and blood are represented in Eqs. (1) and (2), respectively. The model of angularly symmetric geometry was used in the simulation, as shown in Fig. 1. There is a blood vessel throughout the heated perfused tumor tissue. For the tissue domain, the transient Pennes bio-heat transfer equation in cylindrical coordinates is given in Eq. (1).

Figure 3 demonstrates the effects of thermally significant blood vessels with different diameters and averaged velocities on the thermal dose (EM_{43}) profiles.

Five different vessel diameters and blood velocities are used as shown in Table2.

1. J. P. Chiou, The Effect of Longitudinal Heat Conduction on Crossflow Heat Exchanger, *ASME J. Heat Transfer*, vol. 100, pp.346-351, 1978.
2. W. M. Kays and A. L. London, *Compact Heat Exchanger*, 3rd ed., p. 85, McGraw-Hill, New York, 1984.
3. J. P. Chiou, The Advancement of Compact Heat Exchanger Theory Considering the Effect of Longitudinal Heat Conduction and Flow Nonuniformity, in R. K. Shah, C. F. McDonald, and C.P. Howard (eds.), *Compact Heat Exchangers-History, Technological Advancement and Mechanical Design Problems*, HTD vol. 10, pp. 101-121, American Society for Mechanical Engineers, New York, 1980.

圖與表的寫法：圖的說明在圖的下方，表的說明在表的上方，

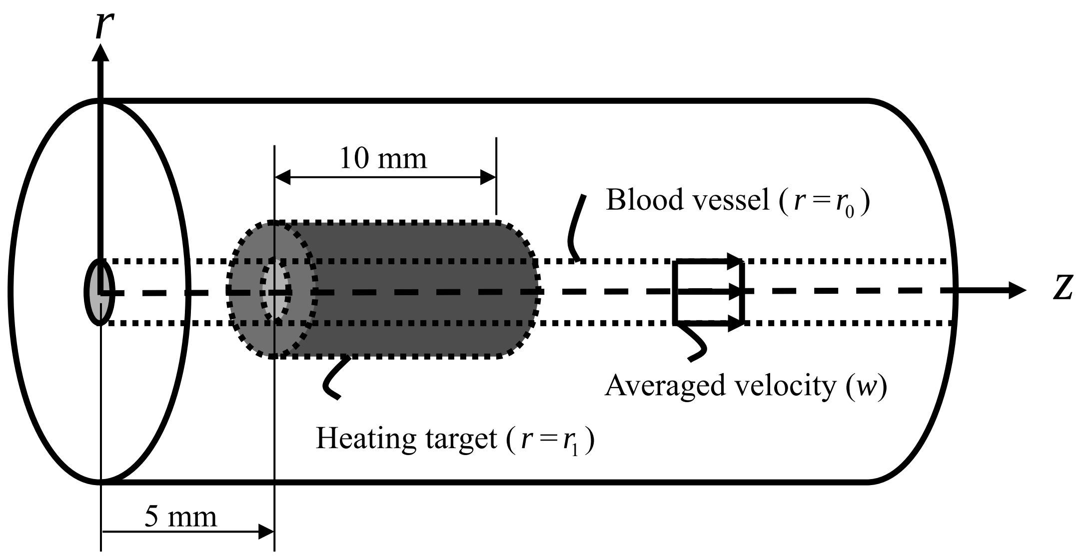

FIG. 1 The geometry for the simulation where heating target (5 mm ≦ z ≦ 15 mm, 0 < r ≦ 5 mm) and the uniform velocities in the blood vessels and their diameters are shown in Table 2.

TABLE 1 Parameters used for Simulation

Symbol	Definition	Value	Unit
ρ_t, ρ_b	Density of tissue and blood	1050	kg/m^3
c_t, c_b	Specific heat of tissue and blood	3770	J/kg °C
r_0	Radius of blood vessel	0.1 ~ 1	mm
r_1	Radius of tumor tissue (the heating target)	5	mm
k_t, k_b	Thermal conductivity of tissue and blood	0.5	W/m °C
w	Averaged blood velocity	3.4 ~ 20	mm/s
W_b	Blood perfusion rate	5	kg/m^{3}s
T_a	Arterial temperature	37	°C
Q	Absorbed power density of tissue and blood	6, 0.6	W/cm^3