

$$\begin{aligned} \textbf{20.} \quad & \frac{\partial u}{\partial t} = a \frac{\partial^2 u}{\partial x^2} + u f \big(u^2 - w^2 \big) + w g \big(u^2 - w^2 \big) + w \operatorname{arctanh} \Big(\frac{w}{u} \Big) h \big(u^2 - w^2 \big), \\ & \frac{\partial w}{\partial t} = a \frac{\partial^2 w}{\partial x^2} + w f \big(u^2 - w^2 \big) + u g \big(u^2 - w^2 \big) + u \operatorname{arctanh} \Big(\frac{w}{u} \Big) h \big(u^2 - w^2 \big). \end{aligned}$$

Functional separable solution:

$$u = r(t) \cosh[\varphi(t)x + \psi(t)], \quad w = r(t) \sinh[\varphi(t)x + \psi(t)],$$

where the functions r = r(t), $\varphi = \varphi(t)$, and $\psi = \psi(t)$ are determined by the system of ordinary differential equations

$$r'_t = ar\varphi^2 + rf(r^2),$$

$$\varphi'_t = h(r^2)\varphi,$$

$$\psi'_t = h(r^2)\psi + g(r^2).$$

Reference

Polyanin, A. D., Exact solutions of nonlinear systems of reaction-diffusion equations and mathematical biology equations, *Theor. Found. Chem. Eng.*, Vol. 37, No. 6, 2004.

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