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Different scenarios in a controlled tubular reactor with a countercurrent coolant. (English)

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Chaos Solitons Fractals 3, No. 5, 537-549 (1993).

Summary: A system of three partial differential equations, representing the dynamics of a tubular reactor with axial diffusion refrigerated by means of a countercurrent fluid, is studied. The PDE system is reduced to an ODE one applying the usual finite differences scheme. The use of a semi- implicit Runge-Kutta method, that has proved itself the most reliable integrator for highly oscillating systems, requires a careful analysis of the numerical integration procedure in order to save computational time. Simulation results show the possibility of chaotic behaviour in a specific parameters range. The variable temperature coolant system does not alter the features of the simplified model with a constant coolant temperature. However, beside the usual period doubling cascade, a mechanism of chaotic transition through type III intermittency and a hysteresis phenomenon are observed. After a preliminary characterization of the chaotic regime by means of the known methods, the paper focuses on the analysis of the new types of scenario.

MSC:

35Q80	Applications of PDE in areas other than physics (MSC2000)
34C15	Nonlinear oscillations and coupled oscillators for ordinary differential equations
65L06	Multistep, Runge-Kutta and extrapolation methods for ordinary differential equations
92E20	Classical flows, reactions, etc. in chemistry

Keywords:

dynamics of a tubular reactor; Runge-Kutta method; chaotic behaviour; hysteresis phenomenon

Software:

YSMP

Full Text: DOI

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