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Flow and Thermal Convection in Rotating Porous Media

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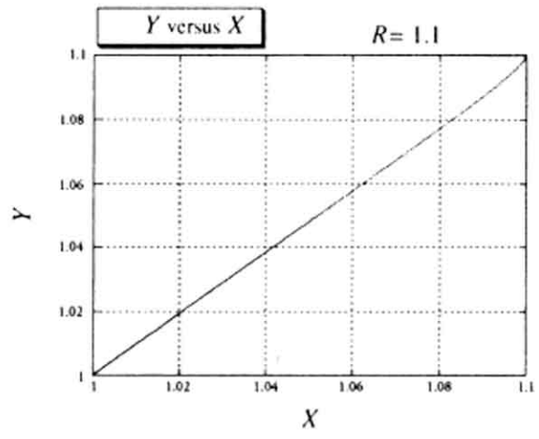
I. INTRODUCTION

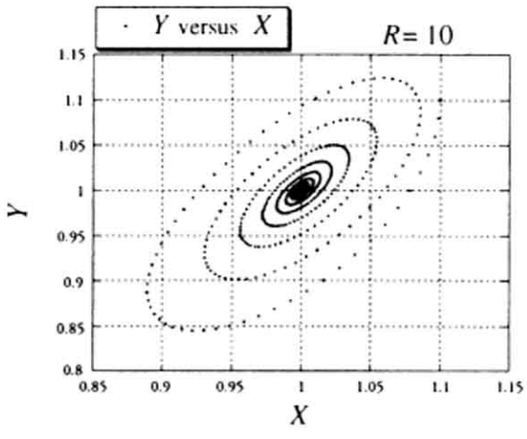
The study of flow in rotating porous media is motivated by its practical applications in geophysics and engineering. Among the applications of rotating flow in porous media to engineering disciplines, one can find the food processing industry, chemical process industry, centrifugal filtration processes, and rotating machinery. Detailed discussion on particular applications has been presented by Nield and Bejan (1999), Bejan (1995), and Vadasz (1997).

Very limited research is available on *isothermal* flow in *rotating* porous media, whereas some results are available for natural convection in rotating porous media; e.g., Palm and Tyvand (1984), Rudraiah et al. (1986), Patil and Vaidyanathan (1983), and Jou and Liaw (1987). Nield (1991b), while presenting a comprehensive review of the stability of convective flows in porous media, found also that the effect of rotation on convection in a porous medium attracted limited interest. The lack of experimental results was particularly noticed.

The main reason behind the lack of interest for this type of flow is probably the fact that isothermal flow in homogeneous porous media following Darcy's law is irrotational (Bear, 1972), hence the effect of rotation on this flow is not significant. However, for a heterogeneous medium with spatially dependent permeability or for free convection in a nonisothermal homogeneous porous medium the flow is no longer irrotational, and hence the effects of rotation become significant. In some applications these effects



(a)



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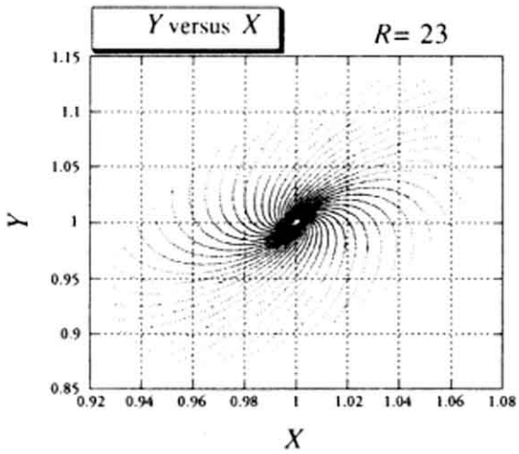

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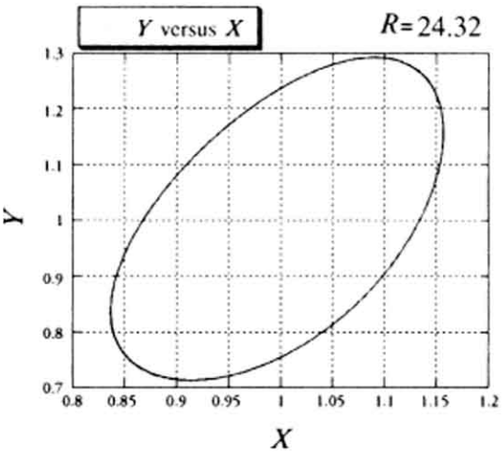

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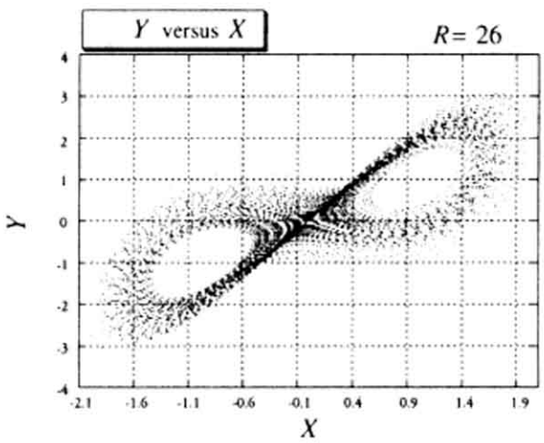

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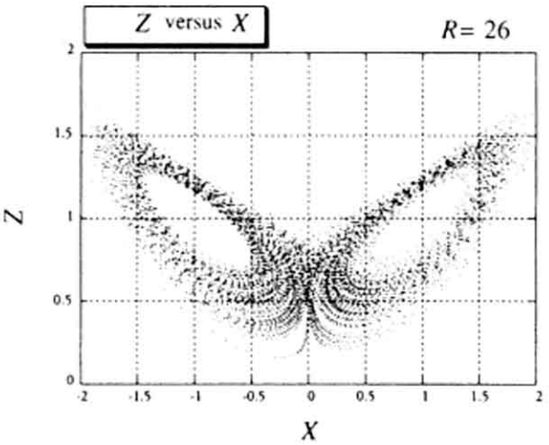

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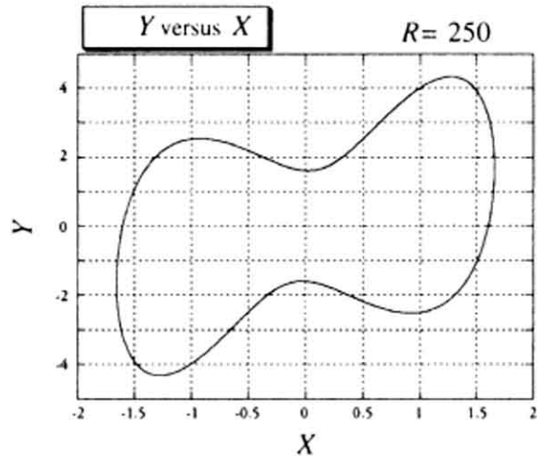

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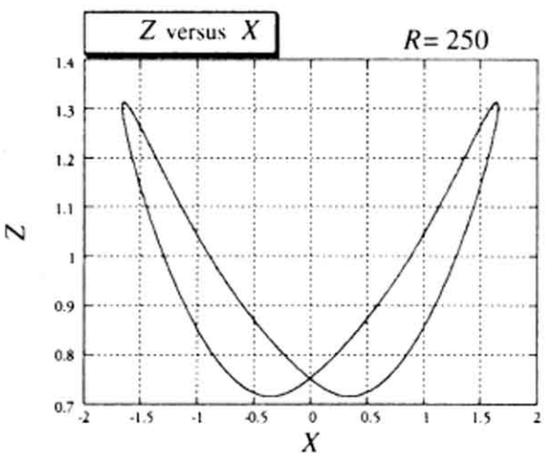

(h)

Figure 12. Different transitions in free convection in a rotating porous layer.