

December 9, 2004

予測工学セミナーの案内

以下の要領で予測工学セミナーを開きます。興味をお持ちの方は是非ご参加下さい。

日時：12月16日(木)午後2時より

場所：工学部第28講義室

2:00 pm–3:00 pm

Werner Koch 博士 (DLR, Germany)

“Resonances in Open Systems”

3:05 pm–4:05 pm

Sotos Generalis 博士 (Aston 大学, U.K.)

“Transition in Plane Parallel Shear Flows with an Internal Heat Source”

4:10 pm–5:10 pm

永田雅人教授 (京都大学)

“Nonlinear solutions of simple plane shear layers with and without a system rotation”

問い合わせ先：藤村 薫 (4561)

“Resonances in Open Systems”

Dr. Werner Koch

DLR Institute of Aerodynamics and Flow Technology, Göttingen, Germany

In a short introduction examples of open resonators with acoustic, electromagnetic, elastic and water waves are given. A simple one-dimensional model problem is used to introduce the concept of ‘leaky modes’ which radiate energy. Numerically we employ ‘perfectly matched layers (PML)’ to solve such radiation problems. In wave guide problems so-called ‘trapped modes’ can occur in addition to leaky modes. Trapped modes do not radiate energy and are therefore important in applications. A well known example are the ‘Parker modes’ in wind tunnel testing, heat exchangers or turbomachinery cascades. Finally, as an example of a two-dimensional open resonator we compute the resonances in a classical laser cavity. The acoustic analogon is the ‘gap tone’ problem which is of importance in airframe noise. Two examples of the latter, namely ‘cavity noise’ and ‘slat noise’ are discussed briefly. The latter is still part of ongoing research.

“Transition in Plane Parallel Shear Flows with an Internal Heat Source”

Dr. Sotos Generalis

Department of Chemical Engineering and Applied Chemistry, Aston University, U.K.

The transition from the uniform steady laminar flow to the chaotic motion of turbulent flow is of great importance in fluid dynamics. The main motivation behind this research project is to study the pre-chaotic bifurcation behaviour of strongly non-linear equilibrium solutions for incompressible internally heated flow in a long channel. In particular it is envisaged that the solutions obtained will be related to the advanced stages of transition identified by the studies involving DNS and experimental investigations in the turbulent regime. During the talk results will be presented for the bifurcation behaviour of the strongly non-linear equilibrium solutions identifying therefore the mechanisms of transition for the fluid flow under the constant pressure gradient or constant flux conditions and for various values of the Prandtl number and of the angle of inclination of the channel flow.

“Nonlinear solutions of simple plane shear layers with and without a system rotation”

Prof. Masato Nagata

Department of Aeronautics and Astronautics, Graduate School of Engineering, Kyoyo University

We consider the bifurcation sequence of typical simple plane shear flows with and without a system rotation about a spanwise axis represented by (1) Couette flow, (2) Poiseuille flow and (3) a flow with a cubic velocity profile.

(1) Plane Couette flow is known to be linearly stable at any finite values of the Reynolds number, thus indicating no bifurcation directly from the basic flow with a linear velocity profile. Nagata (1990) analysed the nonlinear stability of the flow when the system rotation was added and successfully continued a tertiary solution branch to the zero-rotation rate, finding 3D nonlinear solutions of plane Couette flow for the first time. Later, he showed the existence of Hopf bifurcation points on the tertiary solution branch at some rotation rate (Nagata (1998)). We present periodic solutions bifurcating from the Hopf bifurcation points and show that they collide with a 2D streamwise independent solution forming a homoclinic connection when the rotation rate is varied. We also present a branch of the periodic solution which intersects the axis of the zero-rotation rate.

(2) The linear stability of plane Poiseuille flow with a parabolic velocity profile subject to the system rotation is determined by streamwise independent disturbances. We find 2D nonlinear solutions of a streamwise vortex character which arise in bifurcation from the basic flow. The secondary stability analysis indicates an adjustment of 2D multiple solutions with different spanwise wavenumbers. The analysis also predicts bifurcations of three-dimensional flows. We present full nonlinear solutions for three different classes of 3D travelling-wave tertiary flows.

(3) The instability of a flow between two parallel vertical walls with different temperatures becomes purely hydrodynamic provided a fluid with a small Prandtl number limit is considered. The only parameter governing the flow is the Grashof number. Contrary to the cases (1) and (2), the velocity profile of this flow includes an inflection point. After confirming the result of Nagata & Busse (1983) for secondary and tertiary flows we present periodic solutions as the quaternary flow by a numerical experiment. We show in particular that the numerical calculations could capture several unstable periodic solutions representing a transient state. At high Grashof numbers different types of motion coexist as a stable solution of the system. The motion becomes quasi-periodic and a chaotic motion ensues eventually.