UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA STRUTTURALE
Dottorato in Ingegneria delle Strutture
Stefano Bennati (Presidente del Corso)
Via Diotisalvi, 2 – I 56126 PISA
Tel. +39 050 835711 – Fax +39 050 554597
E-mail: s.bennati@ing.unipi.it

AVVISO DI SEMINARIO

Nell'ambito delle iniziative promosse
dal ***Corso di Dottorato in Ingegneria delle Strutture***
e dal curriculum in ***Ingegneria Strutturale***
del ***Corso di Dottorato in Scienze e Tecniche dell'Ingegneria Civile***,

venerdì 29 giugno alle ore 16:00

il **Prof. Alexander P. Seyranian** della *Moscow State Lomonosov University*

terrà un seminario dal titolo

Classical parametric resonance problems

Abstract. A problem of stabilization of a vertical (inverted) position of a pendulum under high frequency vibration of the suspension point is considered. Small viscous damping is taken into account, and periodic excitation function describing vibration of the suspension point is assumed to be arbitrary. A formula for stability region of Hill's equation with damping near zero frequency is obtained. For several examples it is shown that analytical and numerical results are in a good agreement with each other. An asymptotic formula for stabilization region of the inverted pendulum is derived. It is shown that the effect of small viscous damping is of the third order, and taking it into account leads to increasing critical stabilization frequency. The method of stability analysis is based on calculation of derivatives of the Floquet multipliers.

The swing problem is undoubtedly among the classical problems of mechanics. It is known from practice that to set a swing into motion one should erect when the swing is in limit positions and squat when it is in the middle vertical position, i.e. carry out oscillations with double the natural frequency of the swing. However in the literature you can not find formulae for instability regions explaining the phenomenon of swinging. In the present paper the simplest model of the swing is described by a massless rod with a concentrated mass periodically sliding along the rod axis. Based on analysis of multipliers the asymptotic formulae for instability (parametric resonance) domains in the three-dimensional parameter space are derived and analyzed.

The third classical problem is the problem of finding instability regions for a system with periodically varying moment of inertia. An equation describing small torsional oscillations of the system with periodic coefficients dependent on four parameters including damping is derived. Analytical results for instability (parametric resonance) regions in parameter space are obtained. Numerical examples are presented.

Then linear vibrational systems of arbitrary degrees of freedom with periodic coefficients depending on three independent parameters: frequency and amplitude of periodic excitation, and damping parameter are considered with the assumption that the last two quantities are small. Instability of the trivial solution of the system (parametric resonance) is studied. For arbitrary matrix of periodic excitation and positive definite damping matrix general expressions for domains of the main (simple) and combination resonances are derived. Two important specific cases of excitation matrix are studied: a symmetric matrix and a stationary matrix multi-plied by a scalar periodic function. It is shown that in both cases the resonance domains are halves of cones in the three-dimensional space with the boundary surface coefficients depending only on the eigenfrequencies, eigenmodes and system matrices. The obtained relations allow to analyze influence of growing eigenfrequencies to resonance domains. As a mechanical example Bolotin's problem of dynamic stability of a beam loaded by periodic bending moments is considered and solved.

Referente dell'invito: Paolo S. Valvo.
Il corso sarà tenuto nella sala riunioni del DIS.

Pisa, 20 giugno 2007.

Il Coordinatore del Corso di Dottorato
(*Prof. Stefano Bennati*)