TÓPICOS EN BIOMECÁNICA DE LA PRODUCCIÓN DEL HABLA"

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Las cuerdas vocales en la laringe constituyen un oscilador aeroelástico, que actúa como fuente de sonido en la producción de la voz. Bajo condiciones apropiadas, el flujo de aire que a través de la glotis induce su oscilación. Ésta, por su vez, modula el flujo de aire, el cual, después de pasar y ser modificado por las cavidades oral y nasal, produce la onda de presión que percibimos como voz. El habla resulta de la interacción de la vocalización con la articulación. Los articuladores alteran la geometría del tracto vocal, y en consecuencia, la calidad del sonido vocal. En este seminario, presentamos nuestros progresos en el estudio de la biomecánica de este sistema. Específicamente, discutimos aspectos sobre el modelado matemático de la oscilación de las cuerdas vocales, algoritmos numéricos para análisis de movimientos articulatorios, y técnicas de producción de animaciones faciales del habla por computador.

Topological analysis and symmetry groups for chaotic dynamical systems

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Since the pioneering paper published by Edward Lorenz in 1963, it is known that nonlinear ordinary differential equations can have chaotic attractors to solutions. The single breach to attack the problem of characterizing these chaotic solutions is to investigate their topologies in the phase space. When the chaotic attractor can be embedded within a 3D space, a branched manifold – a template – synthesizing the topological properties of all periodic orbits embedded within the attractor can be constructed. At a more global point of view, the surface bounding the attractor – and their associated template – is interpreted as a bounding torus. Its genus has deep consequences on the way the system must be investigated, in particular, it provides some useful indications to construct the Poincaré section.

All these topological concepts are appropriate to describe 3D chaotic attractors. This is particularly useful to investigate systems with a specific symmetry group G. It will be shown that each symmetric attractor has a unique image attractor – without any residual symmetry – that is locally identical to it but different at the global topological level. Image attractor can be lifted to many inequivalent covering attractors. Some examples are presented with symmetry group as the rotation group, the inversion group, and the group V_4, S_4 and S_6. It will then shown how an order-2 symmetry must be involved to investigate the solar dynamics from the sunspot numbers.

PROBABILISTIC MODELING OF UNCERTAINTIES IN A BIOMECHANICAL MODEL OF VOCAL FOLDS

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The two-mass model used for describing the vocal-fold vibrations, proposed by Ishizaka and Flanagan, has been studied for many authors taking into account that the parameters are deterministic. However, the uncertainties of the parameters are important. Here, a probabilistic approach will be used to model the uncertainties of the main parameters responsible for the changes in the fundamental frequency of the voice signal and the process of voice production will be then analyzed and discussed. Firstly, an algorithm using an implicit numerical method is proposed to solve the problem, i.e. to find the output radiated pressure. Secondly, the probability density functions of the random variables modeling the uncertain parameters are derived according to the Maximum Entropy Principle. Finally, a probabilistic analysis of the fundamental frequency of the voice is performed with respect to the level of uncertainties and its probability density function is constructed. Results are compared with experimental data.