Seminari Workgroup Sistemi Complessi
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Aula Buzano Dipartimento di Scienze Matematiche

Prof. Francesco Derll'Isola

Dipartimento di Ingegneria Strutturale e Geotecnica, Universit'a di Roma La Sapienza,
Laboratorio Strutture e Materiali Intelligenti, Fondazione Tullio Levi-Civita
Cisterna di Latina, Italy

A continuum model for the bio-mechanical interactions between living tissue and bio-resorbable graft after bone reconstructive surgery

Abstract: We introduce a two-constituent porous continuum as a model describing the long-term growth/resorption phenomena in bone tissues grafted with bio-resorbable materials as driven by mechanical loads. The proposed model is able to account for the interplay between mechanical and biological phenomena which are known to be important for the bone tissue synthesis and the resorption of both bone tissue and bio-material. In particular, in the presented model the Lagrangian apparent mass densities of the natural bone and of the artificial material evolve in time according to precise ordinary differential equations. These latter are obtained by postulating a growth/resorption law and suitable constitutive equations conceived to account for the influence on bone resorption and synthesis of the action of different applied external loads as mediated by biological stimulus. The considered constitutive equations are chosen on the basis of the known biological phenomena occurring in bone resorption and synthesis. We present some numerical simulations for rod-bones subjected to axial external load. These numerical simulations allow for the description of the most desirable situation in which a gradual resorption of the artificial material takes place together with the contemporary formation of new bone, finally giving rise to an almost complete replacement of the artificial material with natural living tissue.