**Hypertrophy in skeletal muscle tissue, a model using the finite element method** **approach**

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Skeletal-Muscular system provides the ability to move and to sustain posture. From developing children to elderly, through recovering patients, and athletes, skeletal muscle plays a major role in physical and psychological health. According to World Health Organization, physical inactivity is the fourth leading risk factor for global mortality and a major factor in noncommunicable diseases, such as cardiovascular, cancers, and diabetes. Therefore, deep understanding of the relations between physical activity, exercise, and the biological responses at tissue level is important in order to improve therapies and recommendations

Skeletal muscle is an adaptive soft tissue, which means it can grow (hypertrophy) or shrink (atrophy) according to stress adaptation. Adaptation to restricted motion, as in the case of bone fracture, surgical recovery, or spinal cord injury, leads to muscular atrophy. Conversely, physical health in general, or muscle development in athletes, depends on the right training program. From experimental studies and clinical observations, it is known that external stress promotes the activation or inhibition of certain biochemical species related to the hypertrophy process. On the other hand, theoretical development of the biological soft tissue adaptation is not evolving as fast as experimental studies.

From the stand point of engineering, skeletal muscle can be modeled as a nonlinear elastic material. However, the modeling of the mechanics of growth, the increase in mass of a material, is not a field as developed as the modeling of classical engineering materials. Thus the modeling of skeletal muscle tissue growth, from the engineering perspective, is a developing field. Moreover the biochemical processes related to hypertrophy are not fully understood neither how mechanical loading affects those processes. With those ideas in mind, the aim of this research is to model, computationally, the process of hypertrophy in skeletal muscle tissue, due to mechanical loading stimuli and its biological responses. (Mention the big problem, why it has not been studied?)

This research considers some of the biochemical species and the muscle size as populations related in a dynamic system. From this system, muscle size is treated as strain and linked to muscle tissue mechanical response. Muscle stress and a set of rules defines whether tissue grows or not. The new muscle tissue size modifies population dynamics and mechanical response, thus a hypertrophy loop is established.

The skeletal muscle hypertrophy model developed in this research will support the design of the right therapy for atrophied muscles, and the right training program for the general public and athletes. This research will contribute to the development of a mathematical model for muscular tissue growth as well as to the problem of implementation of nonlinear theory for growing materials.