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Review of the PhD Thesis
Mathematical Modelling and Examination of Interactions between Bone Substitute, Mandibular Living Tissue and Tooth Implant
by
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General comments.
The review was prepared on the basis of the agreement Nr.1100/R0026/2021 between the Warsaw University of Technology and the reviewer. The presented thesis was created at the Faculty of Production Engineering (now Faculty of Mechanical and Industrial Engineering) the Warsaw University of Technology and the supervisor is Professor Tomasz Lekszycki. Taking into account the aim of the work, theses, obtained results and the presented conclusions I qualify the reviewed thesis to belong to the discipline of Mechanical Engineering. The title surely reflects the content of the thesis and its subject is topical and of a certain importance.
The main objective of the work is to present a novel model for propagation and decay in time of biological signal for bone reconstruction and to describe the motion of bone tissue-bone substitute material interface.
The author achieved this goal in a very satisfactory way.
In fact, it can be said that the purpose and scope of the work presented by the PhD student are very significant, ambitious and regards an extremely interesting research area. It has potential practical significance for planning and carrying out appropriate medical procedures. Compiled dissertation presented in the doctoral thesis gives a good example of research on the edge of mechanics, biology and medicine, necessary to achieve progress in solving the important issues dealt with. Furthermore it is worth emphasising that the author planned and implemented independently his research program by individuating the most important aspects of the phenomenology involved in bone reconstruction during post-surgical operations.

Scope of the work
Abstract of thesis and of its chapters.
The content of the whole thesis can be resumed as follows:
The main aim of the thesis is to propose a new mathematical model of bone remodelling in presence of bone substitute implant. In the thesis, it is determined how to choose bone substitute to get the behaviour which is the closest possible to the bone natural one. Biomechanics behaviour have been mathematically modelled and new mathematical relationships are proposed to mimic natural bone behaviour. The most original contribution consists in separating the biostimulus caused by mechanical loading from the stimulus inducing bone growth or absorption.
The new model predictions are compared with X-ray evidence: it correctly predicts the localisation of synthesis and resorption of the bone tissue both in normal healthy mandible and in edentulism cases. Next the model is tested to predict the interaction between bone tissue, bone substitute material and a dental implant and the motion of the interface between the bone substitute material

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There are few typing errors: a simple further revision by the author should improve the quality of the text to reach an excellent result

- assumptions,

More emphasis should be spend on the basic assumptions on which the thesis is based.
The minor stylistic and typing errors do not reduce the value of the work in a noticeable way: the author can improve easily the text.
I conclude stating that, in my opinion, the author has shown in this thesis that he is able to conduct scientific research on his own.

Final conclusions

The dissertation concerns current and important problems. The methods chosen for solving them were correctly selected and the conclusions, albeit too synthetic, are satisfactory.
The thesis brings important new elements in this field.
On the basis of the evaluation of the presented work, I can state that the doctoral dissertation of Mr. Yunuhén Hernández Rodríguez meets the requirements for doctoral dissertations and I am applying for admission of the work to public defence in front of the Scientific Council of the Mechanical Engineering Discipline of the Warsaw University of Technology.
Taking into account the scientific value of the presented work, achievements in the field of scientific publications, active participation in international scientific conferences, obtained grants and completed scientific internships I can state that this an outstanding thesis.
I conclude that the presented dissertation meets the requirements set out in the Act of March 14, 2003, "About degrees and academic title as well as degrees and title in art "and I am asking for it admission to public defence."

Francesco dell'Isola

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