World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:15, No:04, 2021

A Neural Network for the Prediction of Contraction after Burn Injuries

Authors : Ginger Egberts, Marianne Schaaphok, Fred Vermolen, Paul van Zuijlen

Abstract : A few years ago, a promising morphoelastic model was developed for the simulation of contraction formation after burn injuries. Contraction can lead to a serious reduction in physical mobility, like a reduction in the range-of-motion of joints. If this is the case in a healing burn wound, then this is referred to as a contracture that needs medical intervention. The morphoelastic model consists of a set of partial differential equations describing both a chemical part and a mechanical part in dermal wound healing. These equations are solved with the numerical finite element method (FEM). In this method, many calculations are required on each of the chosen elements. In general, the more elements, the more accurate the solution. However, the number of elements increases rapidly if simulations are performed in 2D and 3D. In that case, it not only takes longer before a prediction is available, the computation also becomes more expensive. It is therefore important to investigate alternative possibilities to generate the same results, based on the input parameters only. In this study, a surrogate neural network has been designed to mimic the results of the one-dimensional morphoelastic model. The neural network generates predictions quickly, is easy to implement, and there is freedom in the choice of input and output. Because a neural network requires extensive training and a data set, it is ideal that the one-dimensional FEM code generates output quickly. These feed-forward-type neural network results are very promising. Not only can the network give faster predictions, but it also has a performance of over 99%. It reports on the relative surface area of the wound/scar, the total strain energy density, and the evolutions of the densities of the chemicals and mechanics. It is, therefore, interesting to investigate the applicability of a neural network for the two- and three-dimensional morphoelastic model for contraction after burn injuries.

Keywords : biomechanics, burns, feasibility, feed-forward NN, morphoelasticity, neural network, relative surface area wound
Conference Title : ICBCBBE 2021 : International Conference on Bioinformatics, Computational Biology and Biomedical Engineering
Conference Location : Boston, United States
Conference Dates : April 22-23, 2021