**Summary**

In this thesis both mathematical model of the human forward fall as well as numerical model of the human upper extremity have been proposed and analysed. The forward fall model proposed in this paper enables one to estimate the vertical ground reaction forces acting on the hands in various scenarios of the human falling process. The obtained numerical simulations fit with other results presented in the literature, both from a qualitative and quantitative point of view. Moreover, the simulations show that the parameters describing the human body and parameters modelling biomechanical properties between the palmar cartilages and the ground have an essential influence on the obtained results.

It should be emphasized that the developed model has some limitations. First of all, the movement of the shoulder grid with respect of the torso and stiffness/damping properties of the shoulder joint have not been implemented in our model. Moreover, the horizontal component of the ground reaction force has not been considered. Nevertheless, the mentioned limitations may be of interest for our future study.

The choice of a linear material law is justified by small displacements of the radius bone observed during compressive tests presented in the literature. Although all bones have been modelled as a linear elastic isotropic material, in our opinion, the applied simplification should not significantly affect the ability of the proposed model to predict fracture sites and failure load of the radius bone under loads resulting from a forward fall. The variability of Poisson's ratio has not been evaluated in our investigations.

The performed numerical investigations with the time history of the GRF that occur during the falling process in the forward direction on the outstretched arms are sufficient to determine potential fracture sites and the obtained results agree with numerical/experimental results presented in the literature. In addition, the obtained results indicate that the direction of load applied to the radius have a strong impact on the fracture strength of this bone. It means that falls from a standing position on the outstretched arms generate the value of GRF which can exceed the mean human distal radius fracture threshold. Moreover, we have also shown that the maximal strain criterion seems to be more useful for the estimation of the fracture site than the appropriate von Mises stress criterion. Although we obtained various numerical results, unfortunately we were unable to compare these results with own experimental studies from a quantitative point of view. However, the obtained numerical results show that our model provides a realistic estimation of radius bone strain, fracture strength and fracture side estimation under various loading scenarios simulating a forward fall.

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