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ON DEVELOPING SUBJECT-SPECIFIC HUMAN BODY MODELS FOR CLINICAL AND INDUSTRIAL APPLICATIONS

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Summary: Subject-specific biomechanical models start to help engineers to design personal devices and assess injury risk and to doctors to provide patient-specific health care and treatment. As a person-specific human body model is demanding to be developed, scaling, personalization and morphing procedures apply for the necessary level of detail. All the procedures address a reference model, which is updated based on global population dimensions, global subject-specific dimensions or local subject-specific dimensions, particularly. The scaling procedure updates the global dimensions of the reference model to describe an average representative of the population group with the given anthropometry. Only the major characteristics like total height, total mass, gender and age apply. Those global parameters are applied to scale particular human body segments separately. The work shows a scaling algorithm leading to the population-based modeling to be exploited mainly for designing the generic transport safety systems. The scaling approach is the first step for personalization. Whilst scaling changes only the global dimensions based on the general population group anthropometric parameters, personalization updates the local geometrical and biomechanical details of the particular human body segments, which leads to a particular subject-specific model. Such subject-based modeling leads to personalized safety and personal protective equipment, like helmets and other protectors decreasing the injury risk from the impact. The procedure adopting the clothing patterns to develop a subject-specific human body model is presented in the study and compared to the initial scaling approach. For patient-specific modeling, a considerable level of detail must be addressed. Whilst the personalization algorithm concerns global body dimensions adopted from the clothing industry applied for the full human body, the mesh-morphing algorithm using pre-defined landmarks can be easily implemented for developing any human body segment. The presented mesh-morphing algorithm using radial basis functions to morph a template model is presented to develop a given patient-specific geometry. All three approaches are discussed from the point of view of transportation safety, personal protective equipment and person-specific health care and treatment.