

Multibody Dynamics Methodologies for Road Accidents

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ABSTRACT

Multibody dynamics models can be used to investigate and reconstruct complex road accidents, since their formulations are suitable for vehicle dynamics as also for impact biomechanics [1]. In this work accident reconstruction methodologies using multibody dynamics formulations were developed based on 3D-Multibody rigid dynamics. These methodologies have proved to be adequate for accident reconstruction [2], however more adequate contact-impact models have been implemented using a modified Hertzian contact model [3], this model is three-dimensional and uses the mathematical properties of ellipsoids. It also uses the bounding boxes concept.

Computational three-dimensional simplified models were developed, a four-wheel vehicle, a motorcycle and a human biomechanical model. The characteristics of the models could be adapted to match real accident conditions, so that a wide range of the daily traffic accidents could be investigated.

The multibody models includes plastic elements, plastic hinges, in order to take into account the plastic deformation of the vehicle that allows the separation of the bodies within the same mechanical system. This methodology can be applied in extreme severe accidents, for instance, when a vehicle loose a wheel or the engine separates from a motorcycle.

Examples for different collision scenarios are presented and the benefits of the proposed approach are discussed.

REFERENCES

- [1] J. Ambrósio and M. Silva. Structural and Biomechanical Crashworthiness Using Multi-Body Dynamics. *Proc. Instn Mech. Engrs Vol. 218 Part D: J. Automobile Engineering*, pp. 629-645, 2004.

- [2] R. Portal and J. Dias. Multibody Models For Vehicle Accident Reconstruction. *ECCM 2006 – III European Conference on Computational Mechanics – Solids, Structures and Coupled Problems in Engineering*. C.A. Mota Soares et.al. (eds.). Lisbon, Portugal, June 5–8, 2006.
- [3] H. Lankarani. Contact/Impact Dynamics Applied to Crash Analysis, *Proceedings of the Crashworthiness of Transportation Systems: Structural Impact and Occupant Protection*, pp. 445-473,1997.