SUMMARY

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This thesis aims to provide new knowledge and data regarding the relevance of angular vibration as a risk in freight transport. Also, a new test protocol is developed to allow in-lab freight transport risk simulation taking into account rotational modes (angular vibration). This could allow in one hand a better package optimization, and on the other hand a cost reduction in relation to the potential damages that the transported goods suffer in distribution circles.

To achieve this, the considered starting point was a revision of the main transportation modes used in freight movement and their projected relevance in next years. This analysis highlights the advantages of intermodal goods transport against conventional transport, which compromises a transformation toward standard unit loads in transport and based on full semi-trailers and trailers. Also, road transport will continue being the most relevant, although ship transport for long-distance transport will be preferred over air transport, which is mainly used for high value goods.

The analysis of existing works related to research in transport risks shows that even though ship transport is highly relevant in international good movements, studies related to the potential effect of this transport mode in goods are scarce. Also, in road transport there is a number of data already gathered by different authors, but more information related to the road typologies and geographical locations is needed. This will allow for a better adaptation of real-life effects in test protocols, which are based on mean values, and therefore a consequent reduction of packaging could be achieved alongside with minimization of material, costs and environmental impacts.

This thesis will focus on acceleration, and therefore vibration, that occurs during transport in six different directions, tree lineal and three angular (rotational). Linear acceleration is considered at the moment in the industry as the most relevant one, and consequently tests protocols for freight simulation are designed using just lineal acceleration. The proposed work will cover full monitoring of terrestrial and intermodal transport, identifying and quantifying angular vibration (pitch, roll and yaw). This angular vibrations could have an important influence depending on their intensity, and produce important good damages in transport if not considered in the packaging design. This is especially relevant in road and ship transport, although it is true for any kind of transport mode.

After analysing in detail the main references and test protocols used for transport simulation and the existing equipment, a new test protocol is designed which includes angular vibration. This is a first step towards development of an international recognised protocol which considers as a whole the main risks suffered by goods during transport and distribution.

Finally, the achieved results allow to clearly identify future research lines for advancing the state of the art in relation to risk assessment of goods distribution, simulation of transport conditions, and development of new test protocols and related technologies.