Abstract

Road safety is one of the most important problems in our society. It causes hundreds of fatalities every year worldwide.

A road accident may be caused by several concurrent factors. The most common are human and infrastructure. Their interaction is important too, which has been studied in-depth for years. Therefore, there is a better knowledge about the driving task. In several cases, these advances are still not included in road guidelines.

Some of these advances are centered on explaining the underlying cognitive processes of the driving task. Some others are related to the analysis of drivers' response or a better estimation of road crashes. The concept of design consistency is related to all of them. Road design consistency is the way how road alignment fits drivers' expectancies. Hence, drivers are surprised at inconsistent roads, presenting a higher crash risk potential.

This PhD presents a new, operating speed-based global consistency model. It is based on the analysis of more than 150 two-lane rural homogeneous road segments of the Valencian Region (Spain). The final consistency parameter was selected as the combination of operational parameters that best estimated the number of crashes.

Several innovative auxiliary tools were developed for this process. One example is a new tool for recreating the horizontal alignment of two-lane rural roads by means of an analytic-heuristic process. A new procedure for determining road homogeneous segments was also developed, as well as some expressions to accurately determine the most adequate design speed.

The consistency model can be integrated into safety performance functions in order to estimate the amount of road crashes. Finally, all innovations are combined into a new road design methodology. This methodology aims to complement the existing guidelines, providing to road safety a continuum approach and giving the engineers tools to estimate how safe are their road designs.