SUMMARY

The existence of a visibility that is appropriate to the actual operating conditions is a sine qua non to achieve a safe geometric design. The sight distances required in driving tasks, such as decision-making, stopping, overtaking or crossing, represent an essential parameter in the geometric design of new roads; and they play a key role in all international design guidelines. Nevertheless, once the road has been built and operating, many other surrounding circumstances do determine the actual sight distance available over time.

Moreover, since geometric design guidelines encompass visibility measurements based on the observer and the obstacle located on the roadway, systematic and periodic measurements prove difficult and tedious as well as risky and traffic-disruptive. In engineering practice, it is common to use elevation digital models and geometric design specific programs to establish the visibility conditions on roads; however, the development of new remote sensing technologies expand the possibilities to better estimate the visibility actually available.

LiDAR technology has been enjoying a boost internationally in recent years. It is an important source of information that consists of millions of georeferenced points belonging to all kinds of objects, which represent not only the geometry of the road itself, but also its more immediate surroundings. It is precisely this ability to include all sorts of potential obstacles to vision in the analysis that raised our interest.

This PhD thesis presents a newly developed and tested methodology for the systematic assessment of visibility available on roads that deploys visuals directly drawn against the LiDAR point cloud. To this purpose the concepts of Visual Prism (VP) and Rectangular Prismatic Unit (RPU) have been defined as key elements in this new way of thinking about vision. They represent an alternative to the traditional straight line drawn between the observer and the object.

During the research, the impact on the results of the point cloud density has been analyzed; and this methodology has been compared to the visibility results yielded by known techniques based upon digital terrain models, digital surface models and project profiles in two existing road sections. In general, conventional methods overestimate sight distance compared to the new methodology based on LiDAR data, and in many cases the overestimation is significant..

The development, that displays both visuals and three dimensional point cloud results, also enables to spot the reason for the obstruction of vision. This improvement is practice-ready and could be used while assessing the road and improving the conditions of sight distance and road safety.