Safety is one of the most important requirements in the transportation world. The reduction of the number of road accidents is an always up-to-date argument. In the last decades, the number of fatalities was almost halved together with the related social costs (Figure 1), but still today the accidents number is impressive [3]. Increasing the road safety is an ethical challenge that could save human lives and reduce social expenditures.

The National cluster “Trasporti Italia 2020” establish the Italian development program for the Intelligent Transportation Systems with the partnership of research institutes, universities and companies. Politecnico di Milano, as one of the main partner of the cluster, develops advanced measuring systems for automotive applications.

In this doctoral dissertation two innovative force measuring instruments are presented: two smart wheels for motorcycles and an instrumented steering wheel for passenger vehicles.

### Results

Both of the force sensors have been developed starting from a three spoked model, patented by Politecnico di Milano. An optimization algorithm has been developed and validated by means of Finite Element Analysis. Once obtained the optimal sensor geometry which guarantees the best measuring performance, a 3D CAD model and a FE model have been developed for each sensor. Stress and strain analysis are performed. All the sensors have been manufactured and instrumented with strain gauges whose signals are processed by an electronic board that gives as output the six force components applied in the structure centre. The sensors have been experimentally calibrated, tested and the measuring performances have been evaluated.

By using the motorcycle smart wheels, combined load spectra starting from the vertical loads have been evaluated: applying the dynamics models, the combined load spectra are obtained for both the wheels (Figure 5). Those load spectra could be used in the design phase of new motorcycle components.

By using the instrumented steering wheel some common behaviours between the different drivers have been highlighted. Those behaviours are consistent among both the slow speed manoeuvres and the emergency manoeuvres [2]. Moreover, force variations have been noticed before the high rate vehicle dynamics, which could help shorten the ADAS activation time and increase the user road safety (Figure 6).

### Conclusions

Both of the two force sensors have been developed in this doctoral dissertation are calibrated, tested and the measuring performances have been evaluated. A 3D CAD model and a FE model have been developed for each sensor. Both of the two sensors that have been developed in this doctoral dissertation are combined load spectra are obtained for both the wheels and the instrumented steering wheel have been used to study the driving behaviours in different conditions.

Both of the two sensors that have been developed in this doctoral dissertation are useful to develop some new ADAS which will increase the users’ road safety. Even if those sensors are really different, in future it seems possible to integrate the information.

### References
