

Beyond average speed: Functional data analysis of traffic calming effects

Eva Fišerová

Palacký University Olomouc, Czech Republic

Abstract

Traditional evaluations of traffic calming measures typically rely on speeds recorded at selected locations or on summary measures for entire road sections, potentially obscuring spatial variation in drivers' responses. This contribution presents the statistical framework for evaluating changes in continuous speed profiles using floating car data and functional data analysis [1, 3].

Individual GPS trajectories are represented as smooth speed functions over distance. Mean speed profiles observed before and after the installation of traffic calming measures are compared using a global permutation test and interval-wise testing [2]. The latter identifies statistically significant road sections with statistically significant road sections while controlling the interval-wise error rate. These sections define zones of influence, within which the magnitude of the change is quantified by aggregated and pointwise relative effects.

The methodology is illustrated using real-world data from Spain and Czechia. At a Spanish urban gateway, significant speed reductions of approximately 6% and 9% were identified over road sections exceeding 500 metres. In contrast, no significant changes were found at eight Czech locations equipped with driver feedback signs. The proposed approach moves the evaluation beyond average speeds by determining not only whether speed profiles differ, but also where the differences occur and how their magnitude varies along the road.

Keywords

Functional data analysis, Speed profiles, Floating car data, Interval-wise testing, Traffic calming.

References

- [1] Elgner, J., Ambros, J., Muñoz, M.A., Valentová, V. and Fišerová, E. (2026). Assessing the speed impact of urban traffic calming devices using functional data analysis. *European Transport Research Review* 18, 14.
- [2] Pini, A. and Vantini, S. (2017). Interval-wise testing for functional data. *Journal of Nonparametric Statistics* 29, (2), 407–424.
- [3] Ramsay, J. and Silverman, B.W. (2005). *Functional data analysis*. Springer, New York.