# Hyperbolic-polynomial penalized splines: existence, uniqueness, and reproduction properties

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The advent of P-splines, first introduced by Eilers and Marx in 2010 (see [4]), has led to important developments in data regression through splines. With the aim of generalizing polynomial P-splines, in [1] we have recently defined a model of penalized regression spline, called HP-spline, in which polynomial B-splines are replaced by hyperbolic-polynomial bell-shaped basis functions, and a suitably tailored penalization term replaces the classical second-order forward difference operator.

HP-splines inherit from P-splines all model advantages and extend some of them. Indeed, they separate the data from the spline knots -so avoiding overfitting and boundary effects-, exactly fit exponential data, and conserve two type of 'exponential' moments.

HP-splines are particularly interesting in applications that require analysis and forecasting of data with exponential trends: the starting idea of this work is the definition of a polynomial-exponential smoothing spline model to be used in the framework of the Laplace transform inversion as done in [2, 3].

The talk discusses the existence, uniqueness, and reproduction properties of HP-splines, and provides several examples supporting their effective usage in data analysis.

**Joint work with:** Costanza Conti.

## References

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[4] P.H.C. Eilers and B.D. Marx. Splines, knots, and penalties. *WIREs Comp. Stat.*, 2, (2010) 637-653.