# Development of a general monitoring program for bridge stays and hangers in Wallonia

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Recently, dramatic accidents drew attention to the monitoring of bridges. In this context and as Walloon bridges are aging, the Wallonia Public Service department has decided to launch a research project which aims at remotely keeping track of the time evolution of tension in cables. The present paper reports on the design, implementation and preliminary testing of an accurate and non-intrusive axial force monitoring system. Wireless sensors are used to measure accelerations at selected points along the cables. Vibration measurements are acquired on a daily basis and processed to get estimates of the natural frequencies of vibration of the cable that feed up a numerical algorithm for the axial force identification.

All cables studied in this project are highly tensioned, but their flexural rigidities are not always negligible, although small. Preliminary tests have also revealed that the flexibility of end conditions is actually far from the ideal cases of perfectly hinged or clamped.

Based on these observations, the cables are deemed to be accurately described as pre-stressed Euler-Bernoulli beam anchored to flexible supports. A computationally efficient semi-analytical approach has been derived to calculate the natural frequencies of the structural model. A custom implementation of the well-known Differential Evolution optimization algorithm (Storn and Price, 1995) is then adopted to adjust the model parameters in order to minimize the difference between calculated and measured natural frequencies. Special attention is devoted, within this framework, to the definitions of conditions leading to an accurate identification of the parameters representing the flexibility of the anchorages whenever in presence of noisy experimental frequencies. The delivered talk will cover the mathematical details of the model as well as the practical challenges of its deployment to the whole stock of bridges in Wallonia.

## References

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