

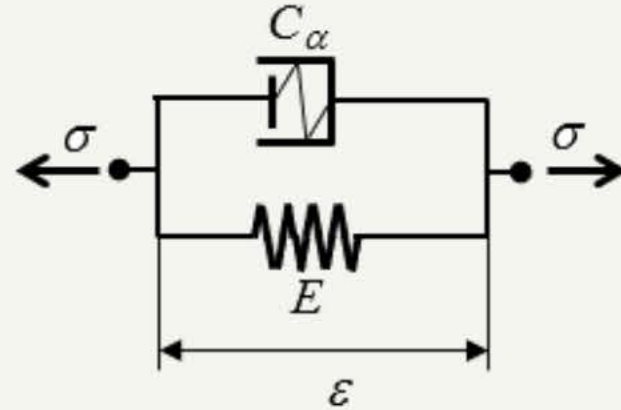
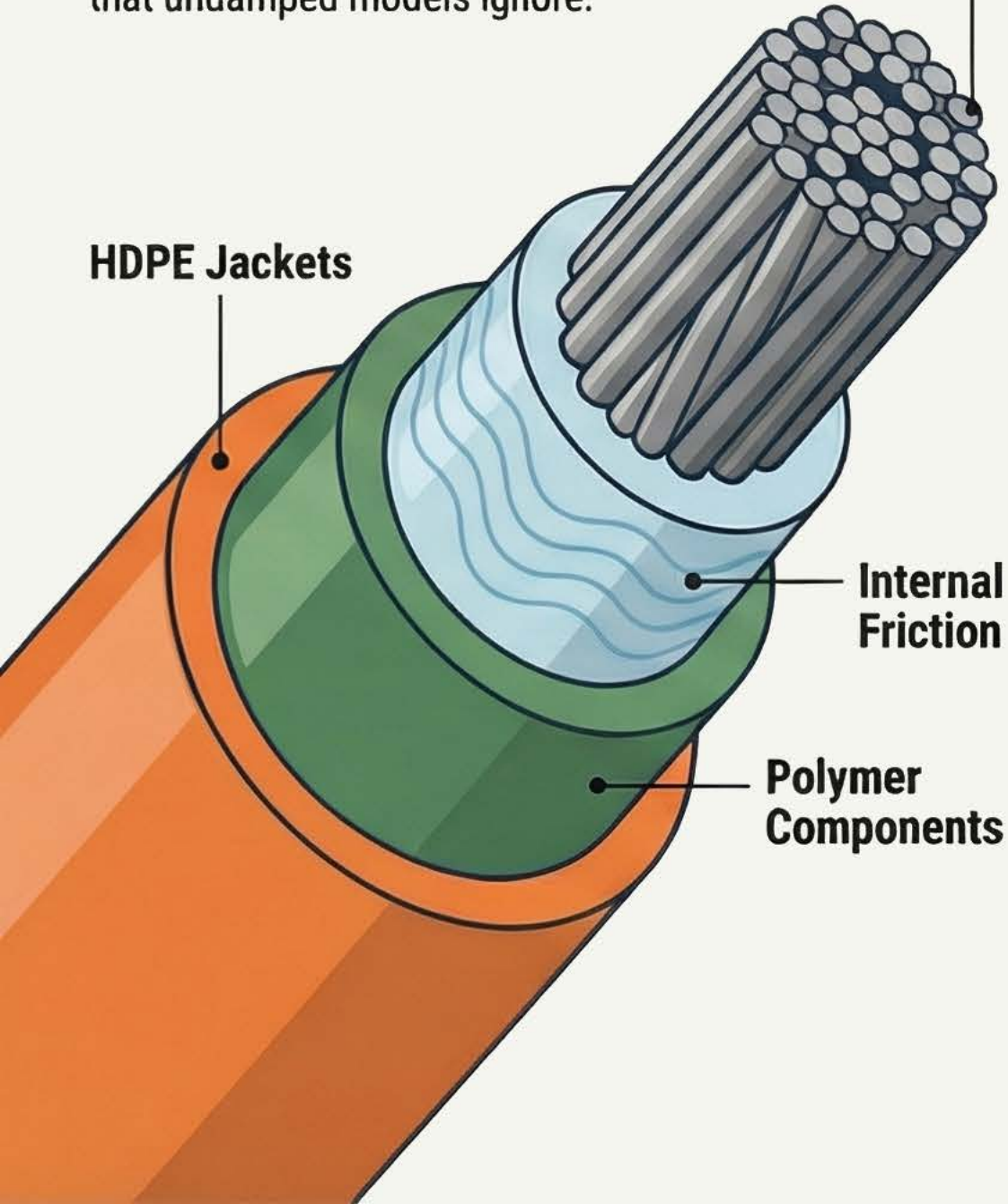
Precise Bridge Cable Monitoring: Integrating Damping for Structural Integrity

Advanced Rayleigh beam model with fractional viscoelasticity and Bayesian statistics provides a high-accuracy, low-cost field solution for cable-stayed and suspension structures.

Beyond Simple Vibration: The Advanced Model

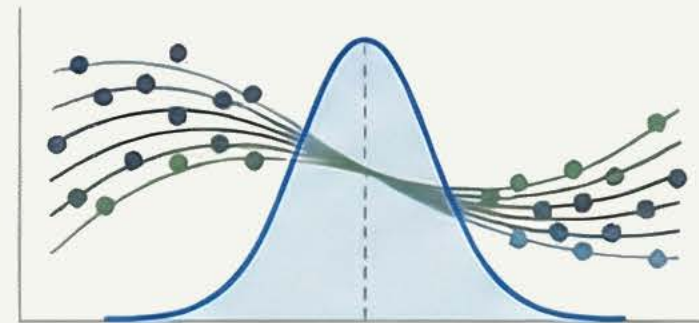
Damping is More Than Just Steel

HDPE jackets, polymer components, and internal friction create significant damping that undamped models ignore.



Modeling with Fractional Viscoelasticity

Using a fractional Kelvin-Voigt model accounts for energy propagation and material memory effects.

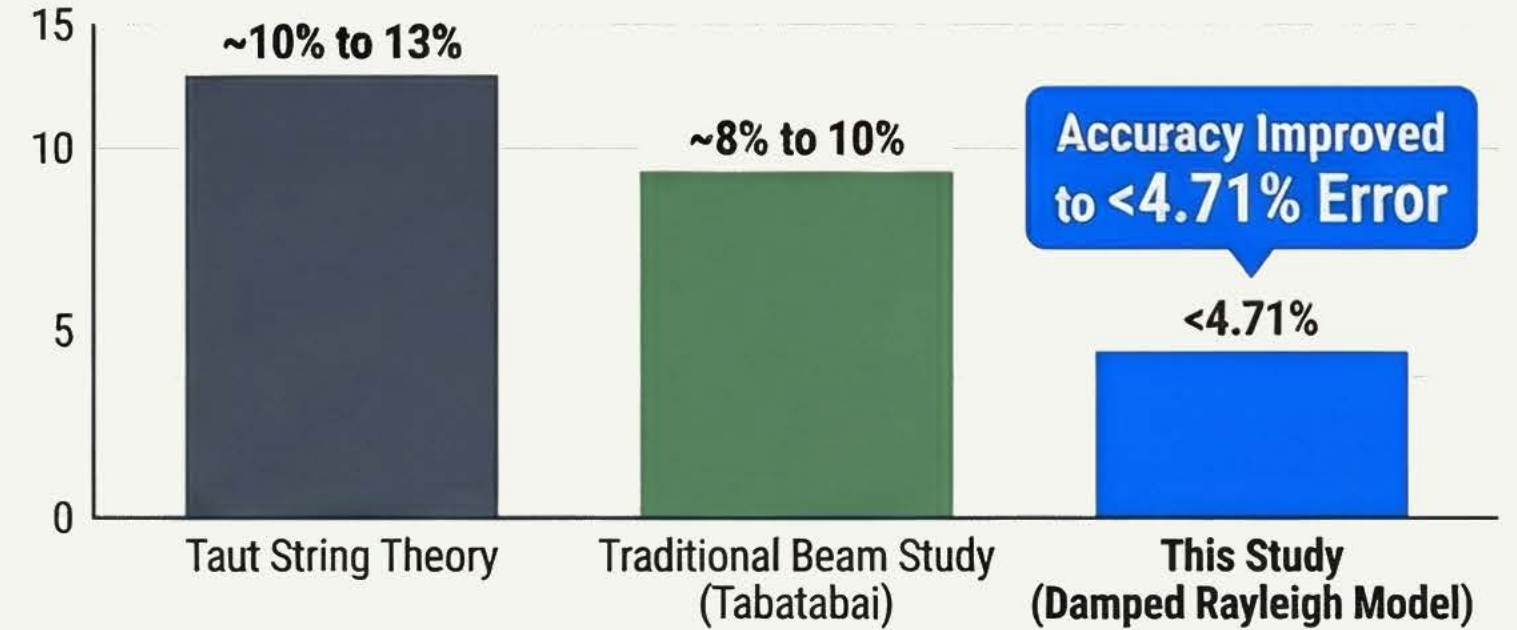


Hierarchical Bayesian Framework

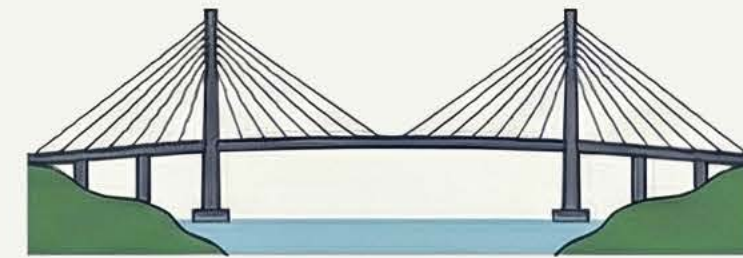
This statistical approach manages noisy field data and balances information across multiple cable segments.

Field Validation and Real-World Results

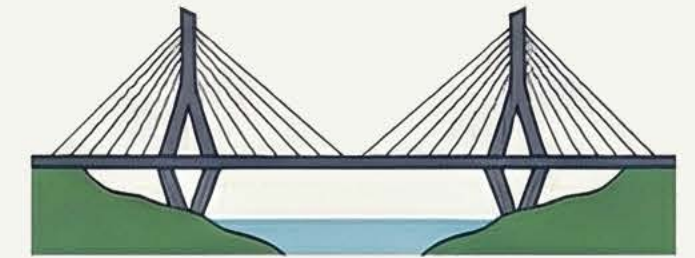
Comparison of Tension Estimation Error (%)



Proven on Major Infrastructure



Phu My Cable-Stayed Bridge (Vietnam) - Validated using real-world vibration data



Hwamyung Bridge (South Korea) - Field tests outperformed traditional theories



Field-Ready for Continuous SHM

The method is fast, low-cost, and lightweight enough for routine structural health monitoring inspections.