WHAT IS CLAIMED IS:

1. A method for characterizing a dynamic behavior of an elongated medium, the method comprising:

generating an input wave signal at an input location along the elongated medium, the input wave signal including a vibro-acoustic wave signal and being selected to excite a mode of vibration in the elongated medium;

measuring a first output wave signal at a first location along the elongated medium spaced apart from the input location, and generating a first electrical signal based thereof, the first electrical signal indicative of a first component of the first output wave signal;

measuring a second output wave signal at a second location along the elongated medium spaced apart from the input location and from the first location, and generating a second electrical signal based thereof, the second electrical signal indicative of a second component of the second output wave signal;

comparing the first and second components of the mode of vibration to one another based on the first and second electrical signals; and

computing a dynamic response of the elongated medium based on said comparing.

2. The method of claim 1, wherein the input wave signal is selected to target a structural natural frequency of the elongated medium to induce a resonance on a predefined frequency band.

3. The method of claim 1 or 2, further comprising measuring the input wave signal at the input location and generating a third electrical signal based thereof, the third electrical signal indicative of a third component of the input wave signal, wherein said comparing further includes comparing the third component of the input wave signal on the third electrical signal with the first and second components of the first and second output wave signals on the first and second electrical signals.

4. The method of any one of claims 1 to 3, further comprising obtaining an analytical model of the elongated medium including at least estimated tonal properties of the elongated medium, wherein the input wave signal is defined by the estimated tonal properties.

5. The method of claim 4, further comprising:

generating an experimental model of the elongated medium based on the first and second signals; and

updating the analytical model based on the experimental model,

wherein said computing the dynamic response is performed using the analytical model and/or the experimental model.

6. The method of claim 5, further comprising associating a quality indicator with the generated experimental model, the quality indicator including a given value of a signal to noise ratio, a presence of an input signal in the measured output signals, and/or a given value of coherence between output signals.

7. The method of any one of claims 4 to 6, wherein said generating the experimental model comprises conducting a modal analysis of the elongated medium and using the modal analysis in said obtaining the analytical model.

8. The method of claim 7, wherein conducting the modal analysis includes predicting, using non-linear functions, a dynamic behavior of the elongated medium at virtual positions beyond regions delimited between the input location and the first and second locations.

9. The method of any one of claims 1 to 8, further comprising:

dividing the dynamic response into a plurality of time windows; and

obtaining a dynamic response of the elongated medium for each one of the plurality of time windows.

10. The method of claim 9, wherein said obtaining the dynamic response for each one of the plurality of time windows includes calculating a signal average over a given frequency bandwidth.

11. The method of any one of claims 3, wherein said comparing includes:

computing a cross-correlation of the first and second electrical signals;

computing a cross-correlation of the first and second electrical signals with the third electrical signal;

computing transfer functions between the first and second electrical signals and the third electrical signal; and/or

computing a predictive transfer function of the elongated medium between the first and second electrical signals based on the computed transfer functions.

12. The method of any one of claims 1 to 11, wherein said generating the input wave signal includes selecting a first input wave signal to excite the elongated medium in an axial shell dominated wave frequency range and/or a fluid dominated wave frequency range.

13. The method of claim 12, wherein said computing the dynamic response is performed solving a mathematical model including the following equations:

$$k_1^2 = k_f^2\left(1 + \frac{\frac{2B_f}{a}}{\left(\frac{Eh}{a^2}\right) - \rho h\omega^2}\right)$$

$$k_2^2 = k_L^2\left(1 + \frac{\nu^2}{1-\nu^2}\frac{\frac{E\mathrm{h}}{a^2}}{\left(\frac{Eh}{a^2}\right) + \left(\frac{2\mathrm{B_f}}{a}\right) - \rho h\omega^2}\right)$$

where k_L, k_f, k_1 k_2 are the compressional, fluid, fluid dominated wave and axial shell dominated wave wavenumbers, respectively, ν is the Poisson ratio of the elongated medium, a is the radius of the elongated medium, B_f is the bulk modulus of external media, E is the Young's modulus of the elongated medium, h is a wall thickness, ρ is the density of the shell material and ω is the angular frequency.

14. The method of claim 13, further comprising plotting a stiffness profile of the elongated medium, wherein said plotting includes:

normalizing the stiffness profile based on a nominal stiffness of the elongated medium;

plotting the normalized stiffness profile of the elongated medium to provide a visualization mean to identify a stiffness differential between the nominal stiffness and the stiffness profile along the elongated medium; and/or

plotting the Young's modulus, the density, the Poisson ratio, the wall thickness and/or a diameter of the elongated medium.

15. The method of any one of claims 1 to 14, wherein the first component of the first output wave signal and/or the second component of the second output wave signal each include a modal frequency.