



# Digital control for smooth vibration testing of structures at resonance

## ■ KEYWORDS

Resonance frequency  
Continuous sine generation  
Resonance search  
Resonance track  
Hopf oscillator

## ■ PATENT

Title: Digital sine generation  
at a predefined amplitude  
following a tracked resonance  
frequency

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Granted : [US](#), [EP](#)

## ■ LICENSING

Exclusive, non-exclusive  
licences and research  
collaborations

## ■ INVENTORS

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## ■ REFERENCE

RETRAVIB032019

## ■ PROBLEM

Mechanical tests at the resonance frequency are more and more recommended in different industrial fields (space, military, automotive, commercial electronics, energy), e.g., fatigue test of wind turbine blades.

This kind of tests allows an energy saving (high level of deformation with a minimum of energy) but are not so easy to carry on. Indeed, these tests are discontinuous and present a lack of precision. It is difficult to reach and keep the frequency at the resonance value because it changes continuously due to the sample degradation.

## ■ SOLUTION

**The invention proposed is a fully digital resonance search, track and dwell (RSTD) test method** in which a non-linear Hopf oscillator generates a continuous sine wave signal. The feedback-generated excitation frequency and its amplitude are used as inputs for the oscillator. The main advantages of the Hopf oscillator are that:

- the whole process is digital;
- the specimen is excited at its resonance by an exciter driven by an oscillating signal with varying frequency and magnitude;
- the excitation frequency tracks the resonance frequency of the specimen thanks to the measured phase lag between excitation base and specimen response (position, velocity or acceleration);
- the vibration magnitude of the specimen is controlled as well;
- the oscillating control signal is generated by a process automatically smoothing frequency and magnitude variations imposed by the control strategy.

## ■ INNOVATION

- Fully continuous test (no stop for frequency resonance measurement)
- Fully digital (low cost)
- Smooth adaptation of frequency and amplitude

## ■ TECHNOLOGY STATUS

TRL 6 : Pilot testing of prototype component or process / of integrated system

## ■ MARKETS

- **Energy:** full-scale testing of wind turbine blades
- **Automotive sector:** fatigue testing on crankshafts
- **Commercial electronics:** test of ball grid array components (solder joints)
- **Space industry:** adhesive bonding characterization, fatigue analysis
- **Military applications:** mechanical tests on weapons, munitions safety tests, packaging testing and suitability of clothing or fabric items intended for military use, vibration and shock tests on aircrew escape propulsion systems
- **Any other application requiring resonance tracking**

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