

Vortex Effect of Optical Cables



Summary of Content

Vortex effects in optical cables primarily manifest as vortex-induced vibrations (VIV), causing mechanical stress and potential signal perturbations in both aerial and submarine fiber systems.

Mechanism of Vortex-Induced Vibration

Vortex-induced vibration occurs when fluid flow, such as wind or ocean currents, interacts with a cable, creating alternating vortices in the wake of the cable. These vortices generate periodic forces perpendicular to the cable axis, causing it to oscillate at frequencies that can resonate with the cable's natural frequency, amplifying vibration amplitudes. In submarine cables, this phenomenon is triggered when currents expose or suspend the cable above the seabed, while in aerial cables, low-velocity wind can induce small-amplitude resonant vibrations.

Effects on Optical Fibers

The oscillations from VIV induce torsional and transverse stress in the optical fibers embedded within the cable. Studies using fluid-structure coupling simulations show that the stress distribution in torsional optical fibers mirrors itself at half-cycle intervals of vibration, and the stress frequency matches the vortex shedding frequency. This stress can lead to fatigue, microbending, and potential signal degradation, especially in long-span installations like optical-fiber ground wires (OPGW) or submarine power transmission cables.

Monitoring and Mitigation

Article Content

Optical Vortex

An optical vortex (OV) is defined as a beam of light characterized by a donut-shaped transverse profile and a spiral wavefront,

Interference of high-order perfect optical vortex beams

We investigate the interference of high-order perfect optical vortex (POV) beams with different topological charges.

FUNDAMENTALS OF VORTEX-INDUCED VIBRATION

What kinds of VIV are there? Self-excited oscillations - this type of VIV is what occurs naturally, i.e., when the vortex-shedding

Generation of Optical Vortex Beams

Optical vortex beams carrying orbital angular momentum (OAM) have found numerous applications in optical manipulation, optical

Multiple scales perturbation analysis on vortex-induced ...

Vortex-induced vibration (VIV) of large-span cables has become a significant engineering problem to be solved. As a

A study of optical vortices with the Talbot effect

The optical Talbot effect has been used to explore the topological charges of optical

Fiber Optic Basics

Fiber Stripping The outer sheath of fiber cables can be removed using electrical cable stripping tools, and scissors or a razor blade

Polarization singularities: Progress, fundamental

In optics, the topological defects normally appear as phase and polarization singularities

(PDF) Torsional Optical Fiber Stress Analysis and Vortex-Induced ...

In this contribution, the finite element simulation model of a 35 kV three-core optical fiber composite submarine cable

Stable optical vortices in nonlinear multicore fibers

Suitably designed multicore fibres can support stable and coherent propagation of high-power optical vortices, find an

Numerical investigation on vortex-induced vibration of vertically ...

Suspended cables are susceptible to vortex-induced vibration (VIV) in the complex marine environment. Previous

Fluid-structure interaction simulation and optical fibre stress ...

Abstract Under the current scouring, submarine cables are prone to be exposed, suspended, and even vortex-induced vibration

Full article: Optical vortices: revolutionizing the field of linear and ...

Light fields embedded with orbital angular momentum (OAM)- also known as optical vortices (OVs)- have truly revolutionized optics

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration ...

At the same time, the above research lacks the analysis of the mechanical response characteristics of the optical fiber

Fluid-structure interaction simulation and optical fibre

Furthermore, the suspended span section of the submarine cable

Case Study: PMD Measurement on Aerial Fiber under Wind-Induced

Wind drives mechanical oscillations in aerial fiber-optic cable installations. Aeolian, vortex-induced, cable-galloping and wake

Fluid-structure interaction simulation and optical fibre

The fluid-structure coupling method and finite element simulation

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration ...

Vortex-induced vibrations can lead to fatigue and friction of submarine cables, which seriously threaten the operational

Case Study: PMD Measurement on Aerial Fiber under Wind-Induced

Vortex-induced vibration occurs under sustained, low-velocity winds and cause optical cable to resonate at frequencies up to 150 Hz

Vortex Induced Vibration Analysis of 500kV Single-Core Optical Fiber ...

It can provide theoretical support for the realization of submarine power cable vortex induced vibration monitoring by using distributed

Simulation analysis of flow field and vortex-induced vibration ...

In this paper, a two-dimensional spring-damping vortex vibration model is established considering the effect of

Generation and detection of optical vortices using all fiber-optic ...

The phase structure of vortex beam was detected by interfering both the beams using simple fiber-optic interferometer.

Experimental study of vortex-induced vibration of stay cables installed ...

To address both illumination issues and the common vortex-induced vibration (VIV) of bridge cables, a perforated

The Hall effects of vortex light in optical materials

For light, its spin can be independent of the spatial distribution of its wave function, whereas its intrinsic orbital

Fluid-structure interaction simulation and optical fibre stress ...

In this contribution, a finite element simulation model of 110-kV single-core optical fibre composite submarine cable is

Vortex Beams: Fundamentals and Applications

Besides optical vortex beams, some other vortices, such as electron vortex beams, neutron atom vortex beams, plasmonic vortices

Optical Vortex | Wavefront, Beam Dynamics & Photonics

Explore the fascinating world of optical vortices, their impact on photonics, and how they're revolutionizing data

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration ...

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration Study of Three-Core Submarine Cable. Journal

Torsional Optical Fiber Stress Analysis and Vortex-Induced ...

To investigate the stress distribution and its development law of the torsional optical fiber during vortex-induced

(PDF) Torsional Optical Fiber Stress Analysis and Vortex-Induced ...

Due to current scouring, submarine cables are prone to be exposed, suspended, and even vortex-induced vibration,

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration ...

Because it is complicated to carry out the vortex-induced vibration experiments of submarine cables, it is more suitable

Simulation analysis of flow field and vortex-induced vibration ...

Our study overcame the difficulty in testing the vortex-induced vibration of submarine cables and provided a viable

Review on Fiber-Optic Vortices and Their Sensing Applications

In this review article, we have discussed the theory of polarization and phase vortices, and then summarized the

Torsional Optical Fiber Stress Analysis and Vortex-Induced Vibration ...

In section 5.2.3 Simulation results of mechanical response characteristics of vortex-induced vibration, specify which

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