Application Note

Advancing beyond

Wavelength Swept Light Source

Measurement Applications

Introduction

This note explains application fields for the Wavelength Swept Light Source (WSLS) and some examples. With its high coherence performance, our WSLS not only achieves a wide distance range at length measurement, but also has high measurement resolution. It can also be able to applications such as optical parts evaluation and optical fiber sensors.

Specifications

Sweep Center Wavelength: 1550 nm (1060 nm also supported)
Sweep Frequency: 150 or 1250 Hz (typ.)
Wavelength sweep Width: >100 nm
Average Optical Output Power: ≥10 dBm
Coherence Length: >100 m

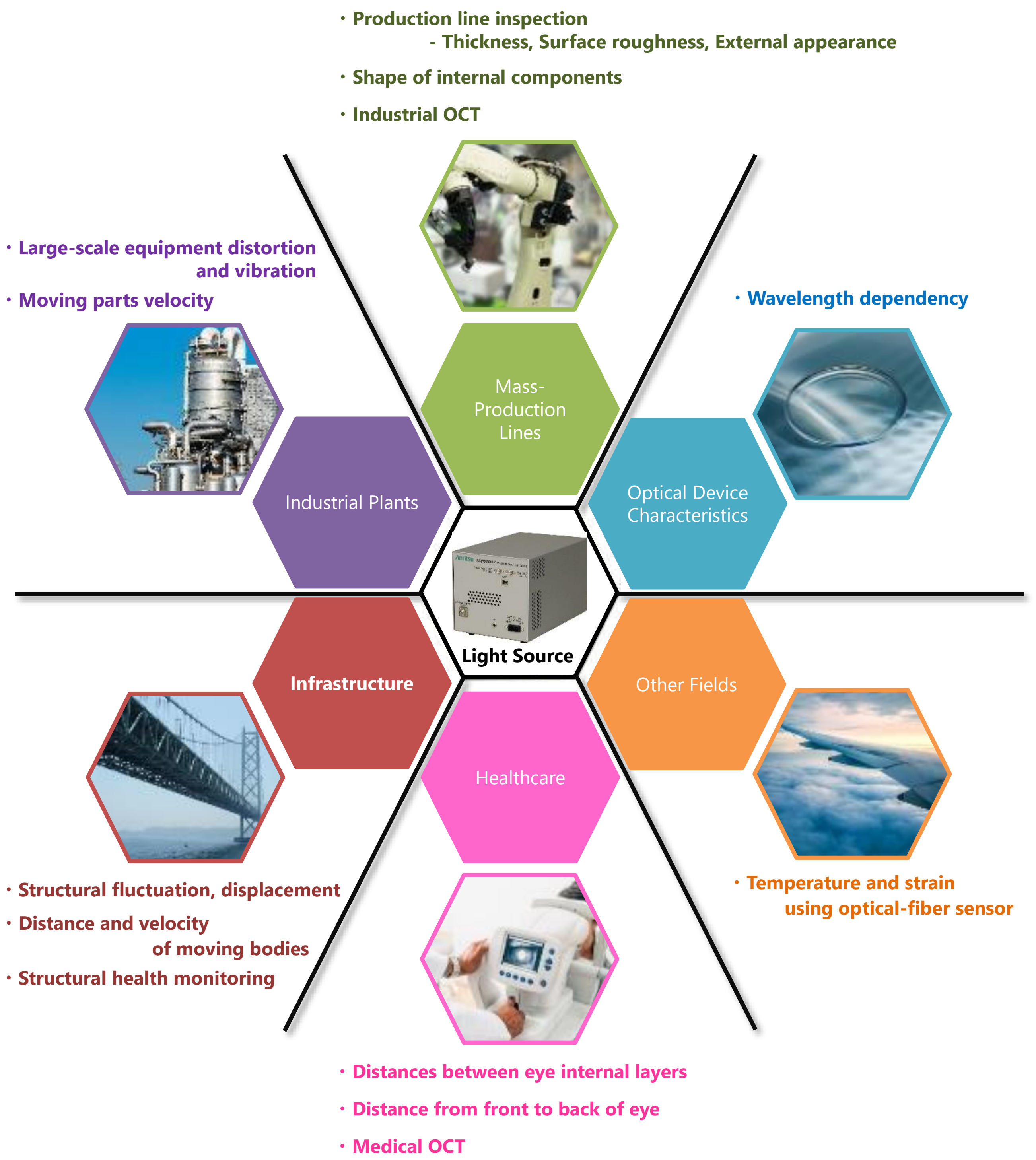
External Appearance

AQA5500P
Sweep Frequency:1250 Hz

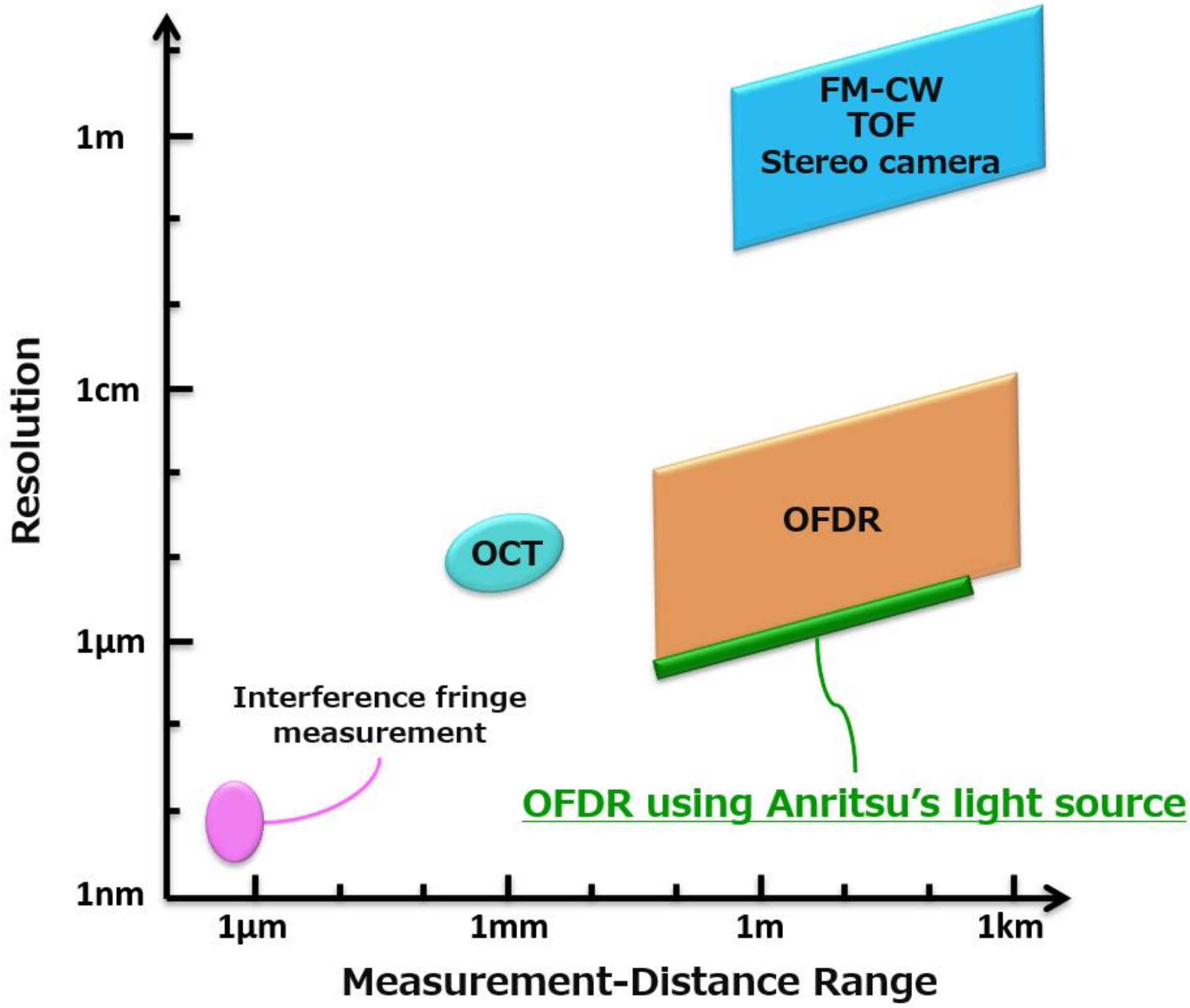
AQB5500P
Sweep Frequency:150 Hz

Contents

Application fields of Wavelength Swept Light Source



The following figure shows the relationship between measurement-distance range and resolution for various free-space measurement methods.



FM-CW: Frequency Modulated Continuous Wave Radar

TOF: Time-Of-Flight

OCT: Optical Coherence Tomography

OFDR: Optical Frequency Domain Reflectometry

The following pages present some examples for each application field. Please refer to them for your related application.

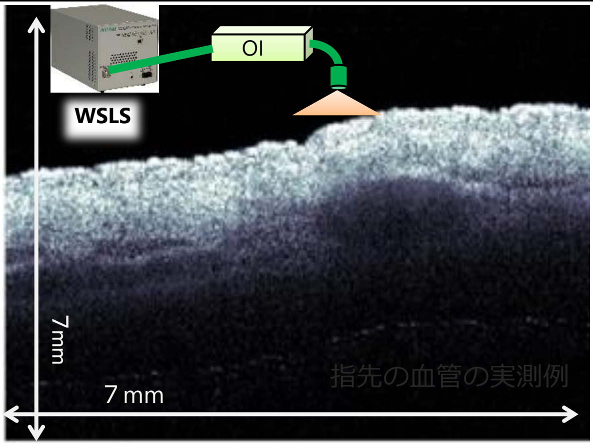
The abbreviations in the figure are shown below.
WSLS: Wavelength Swept Light Source
OI: Optical Interferometer

Healthcare

Ophthalmology

Incorporating this light source into ophthalmology equipment supports precision measurement of the distance from the Anterior segment to Fundus of the eye as well as distances between internal eye layers.

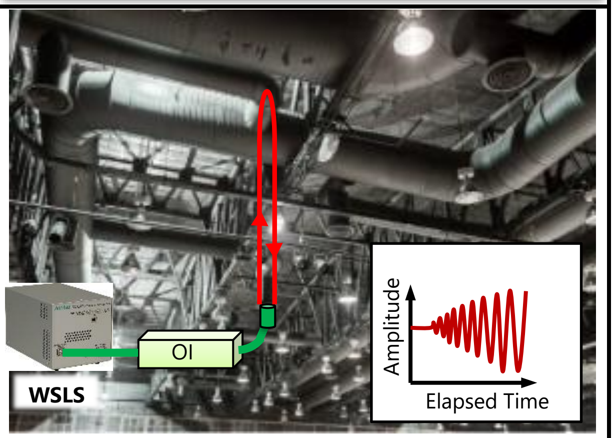
Medical OCT



This light source can be used for optical coherence tomography (OCT) to analyze the internal cross-section structure of the target.

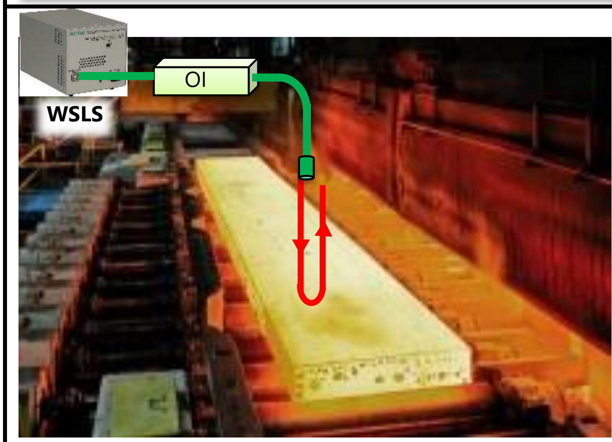
Industrial Plants

Plant Piping Displacement & Vibration



Measuring the distance of plant piping from a remote point can help detect deflections, displacement, and abnormal vibration.

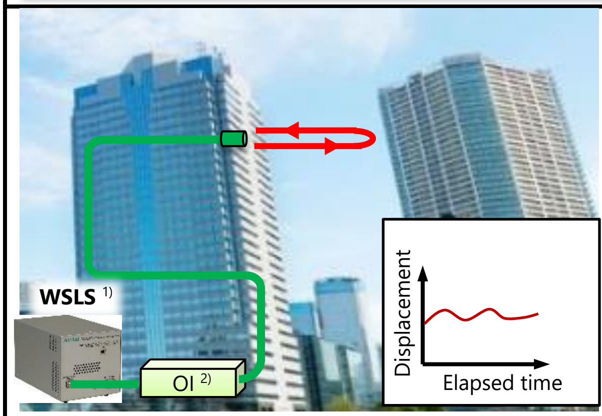
Shape of Hot Materials



Measuring the distance to a hot material from a remote position can be used to determine the surface shape even in the severest measurement environments.

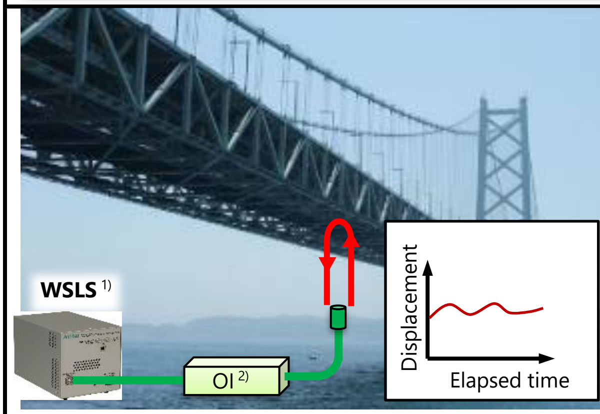
Infrastructure

Distance Between Buildings Earthquake Deviation & Displacement



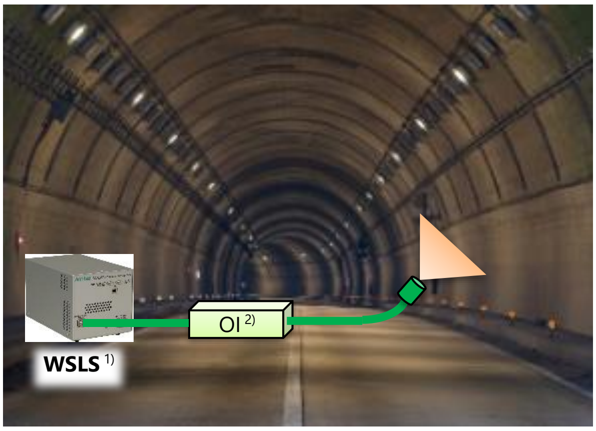
Measuring the distance between buildings in real-time at high speed can detect earthquake-related fluctuation and vibration as well displacement after an earthquake.

Bridge Fluctuation & Vibration



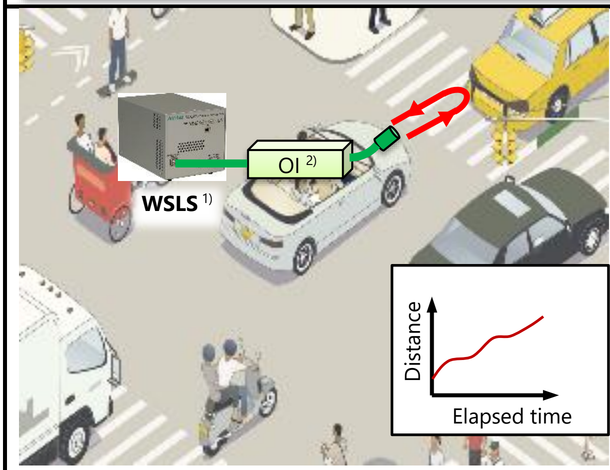
Measuring the distance from a fixed point to the bridge, you can detect fluctuation, vibration, and displacement for long-term periodic monitoring of bridge safety.

Infrastructure Inspection



Inspecting infrastructure such as tunnels by measurement from the ground surface can detect deviation, distortion, and strain in the tunnel internal walls for structural diagnostics.

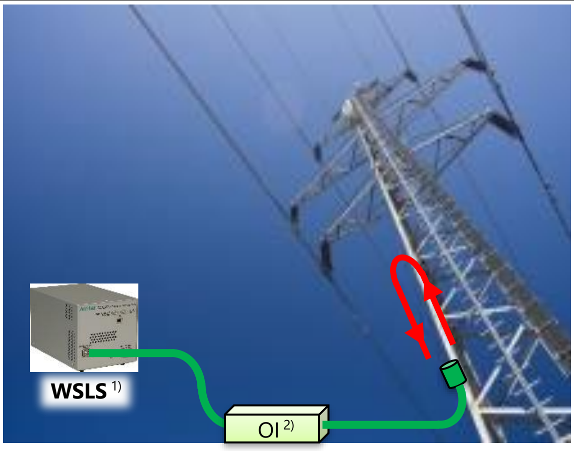
Distance Between Moving Bodies & Relative Speed



Installing the measurement system in moving bodies, such as automobiles, can measure the distance between them and the relative speeds.

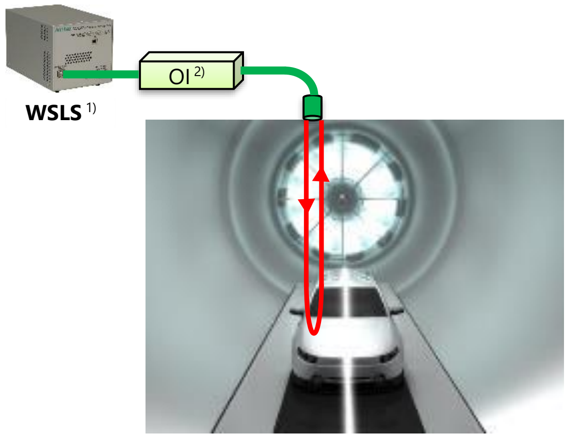
1) WSLS: Wavelength Swept Light Source 2) OI: Optical Interferometer

Steel Tower Inclination



The displacement and inclination of high structures, such as power transmission lines and pylons, can be measured with high precision.

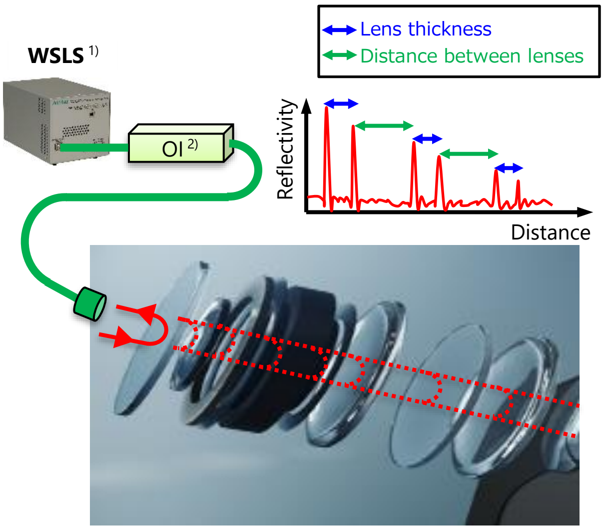
Precision Non-contact Measurement to Fixed Point



High-accuracy, non-contact distance measurement over several meters to a fixed point can detect micron-level vibration and subduction at the target during wind-tunnels tests, etc.

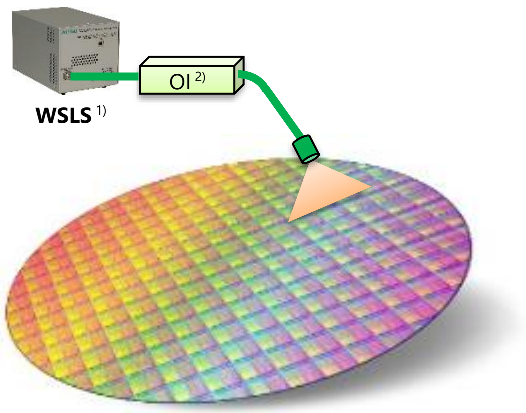
Mass-production Lines

Thickness Measurement of Optical Parts such as Lenses



The thickness of translucent products such as glass and lenses can be measured with high accuracy by capturing light reflected from the front and back surfaces.

Wafer Thickness Measurement



Wafer thickness can be measured from a remote position as well as during epitaxial growth using light reflected from the wafer back face.

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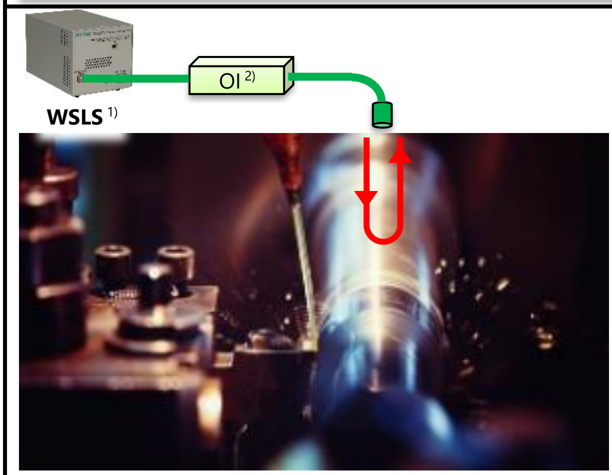
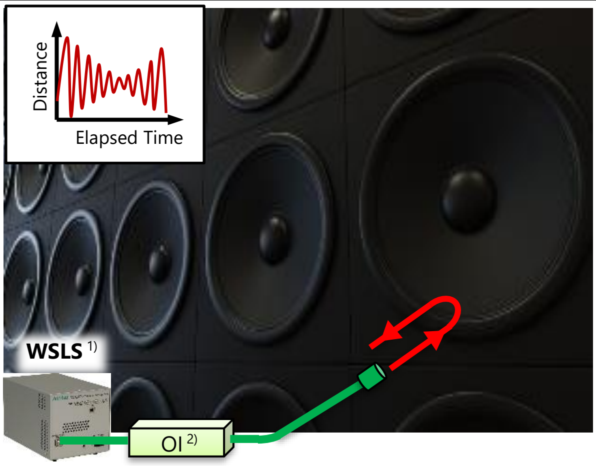
Amplitude Width Measurement of Rotating Parts



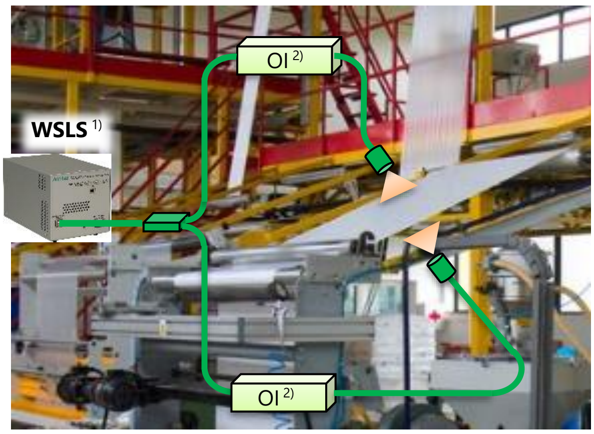
Measuring the distance to rotating parts. such as drills and discs, from non-contact fixed position can determine the part eccentricity and surface deflection.

Speaker Cone Amplitude Deflection and Frequency Measurement



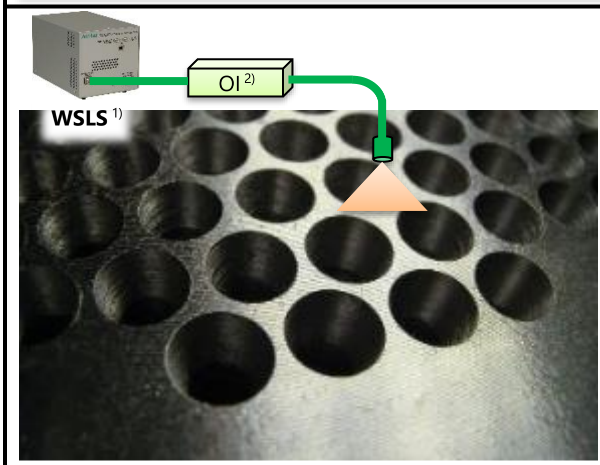
The amplitude width and frequency of products vibrating at high speed, such as speakers, can be measured quickly in real-time.

Thickness & Surface Roughness Measurement of Steel Plates/Films



Light reflected from the surfaces of thick products, such as steel plates, and from planar products, such as films and foods, can be used to measure thickness and surface roughness without effects from product shaking and bending.

Burr & Scratch Detection on Machined Products

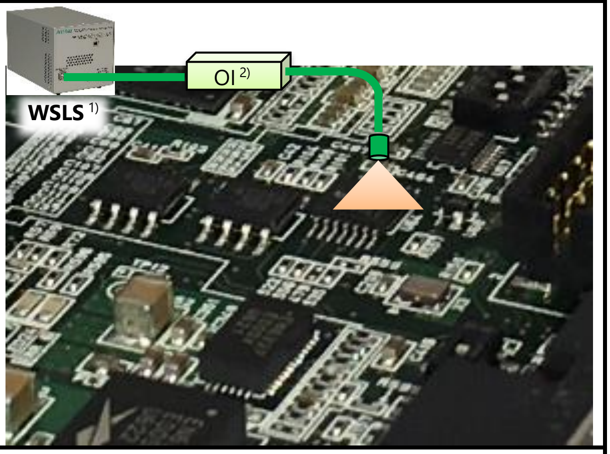


Imperfections in machined products, such as surface irregularities, burrs, and scratches, that are hard to detect by eye can be evaluated accurately even in confined locations by distance measurement from a remote fixed position.

1) WSLS: Wavelength Swept Light Source

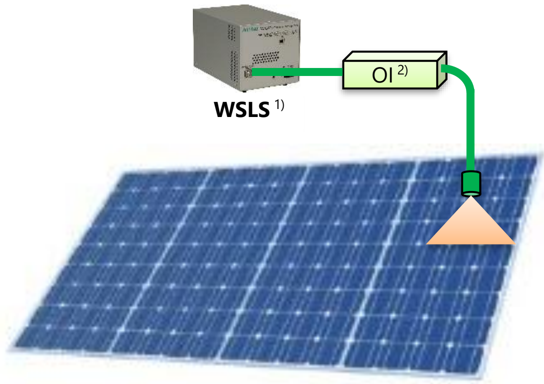
2) OI: Optical Interferometer

Surface Irregularity Measurement on Solder PC Boards



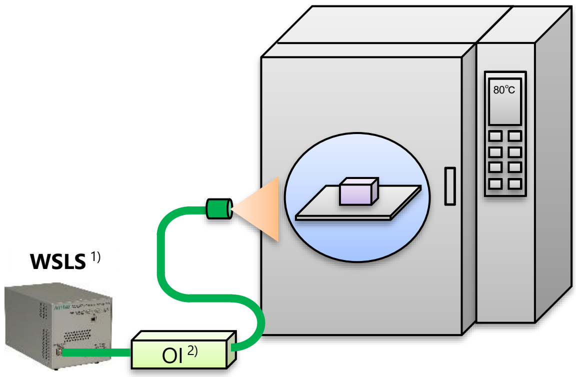
Fine surface irregularities, such as the height of cream solder on printed-circuit boards and adhesives, can be measured with high precision. For example, the amount of applied adhesive can be calculated by measuring changes in fine irregularities.

Industrial OCT



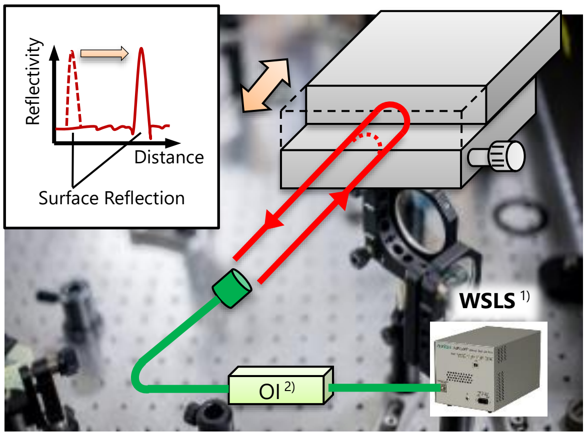
Optical coherence tomography (OCT) using this light source supports analysis of the cross-sectional structure of products. For example, at inspection of solar panels, the presence of open connections between cells can be confirmed by panel surface inspection.

External Monitoring of Thermal Distortion of Test Parts in Temperature Chamber



The thermal distortion of products that are difficult to measure accurately by contact inspection methods, such as products under inspection in a temperature chamber, can be monitored remotely from outside the chamber through a glass window.

Fine Distance Measurement of Moving Stages



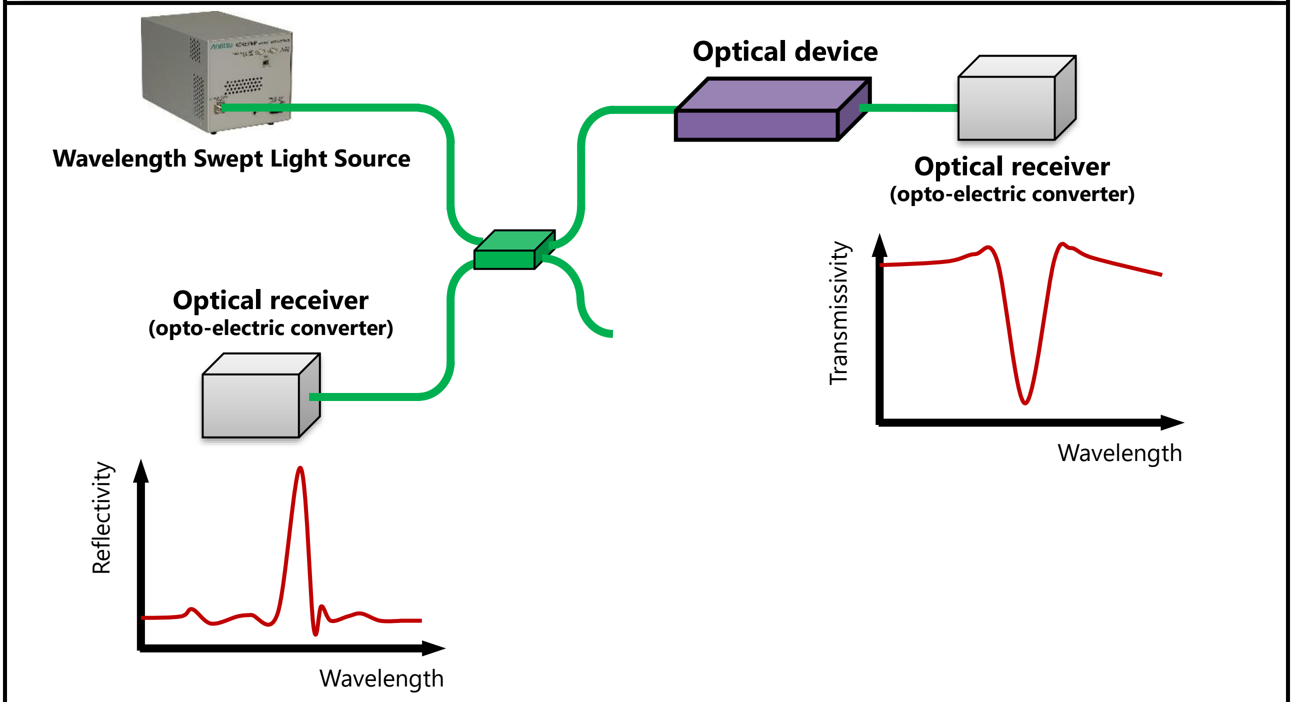
Measuring distance before and after movement of a stage can be used to determine the actual distance moved.
For example, measuring the distance moved in precision systems, such as optical stages, can be used for high-accuracy position determination using the measurement results.

1) WSLS: Wavelength Swept Light Source

2) OI: Optical Interferometer

Optical Device Characteristics

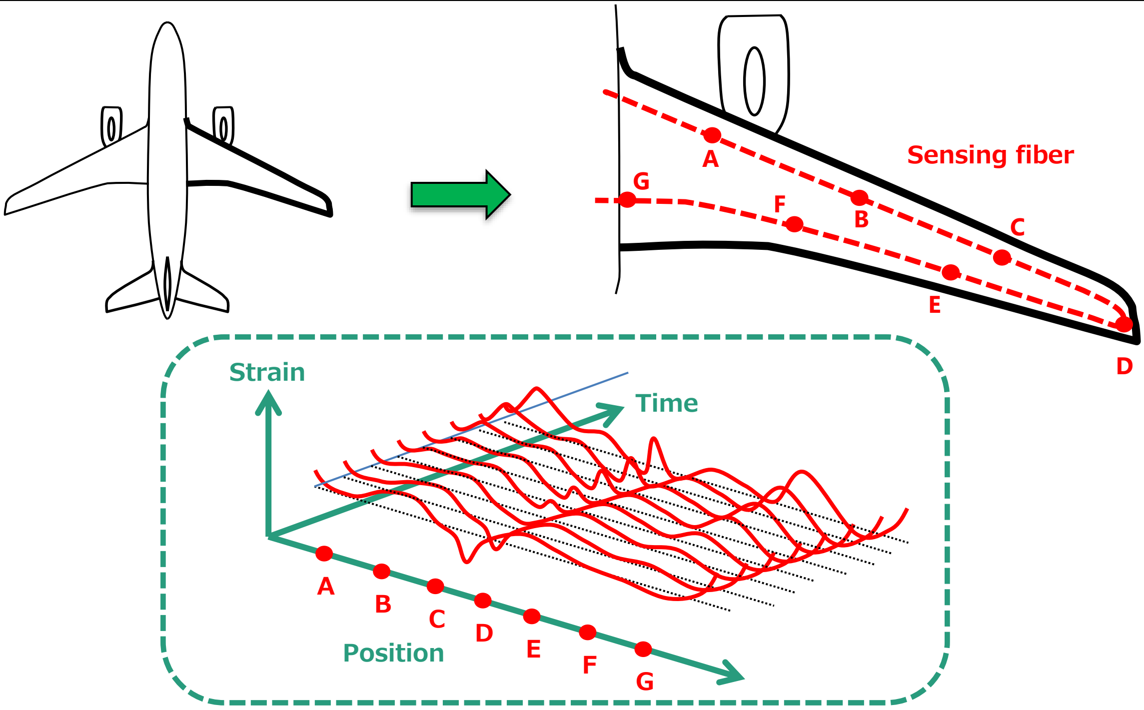
Optical Device Evaluation



The reflection and transmission wavelength-dependency characteristics of optical devices can be measured quickly and at once with a wavelength resolution on the order of 1 pm.

Other Fields

Temperature and Strain Measurement of Large Structures

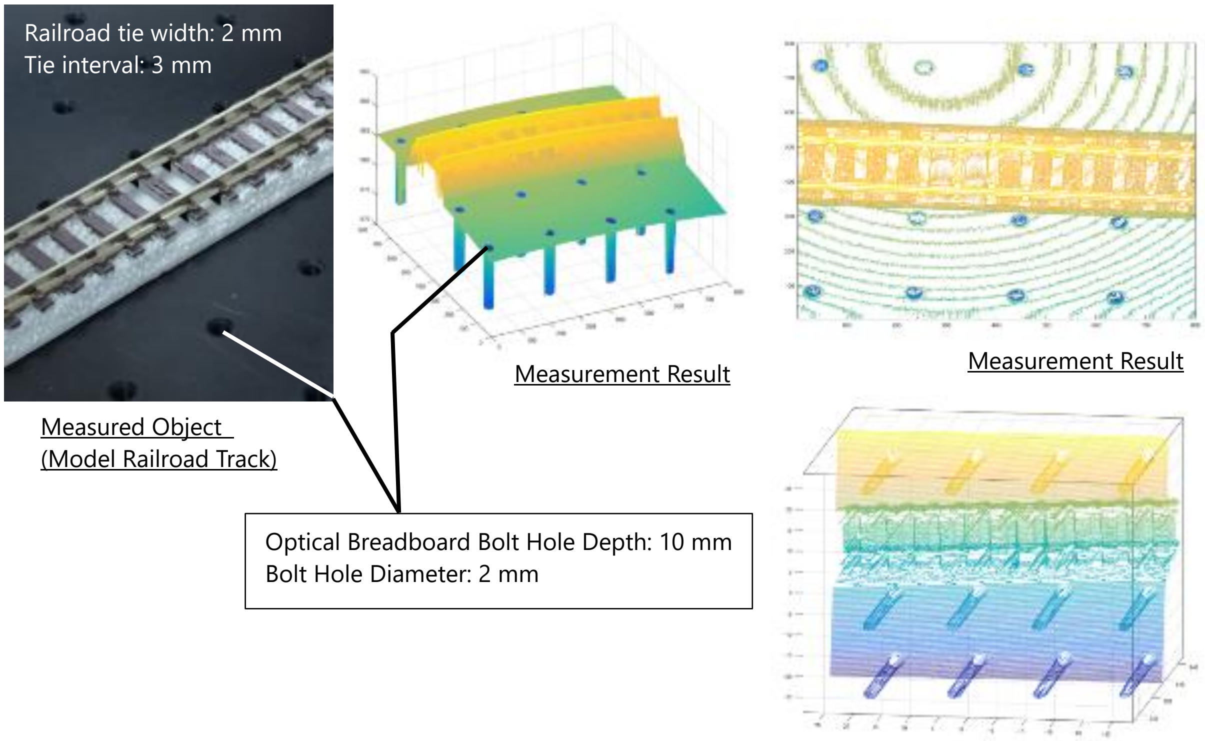


Using an optical fiber as an optical frequency domain reflectometry (OFDR) sensor supports real-time continuous monitoring of temperature and strain changes, such as in the main wing of an aircraft.

The following measurement examples use optical interferometry measurements with the wavelength swept light source to measure the 3D shape of target objects positioned 1 m from the fiber output end face.

Examples of 3D Shape Measurement

Model Railroad Track and Mounting Holes in Optical Breadboard



Measured Object (Model Railroad Track)

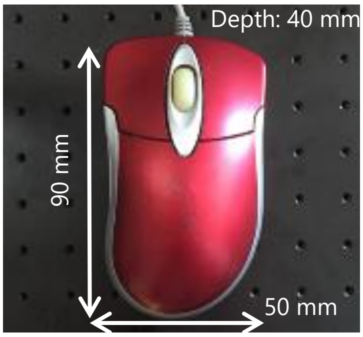
Measurement Result

Measurement Result

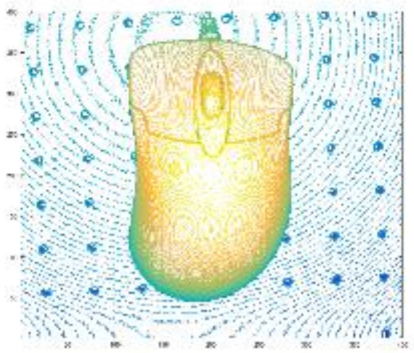
Measurement Result

This example measured the 3D shape of a model railroad track on an optical breadboard positioned 1 m from the fiber output end face. As well as measuring the track shape, the depth of the holes into the optical bench are also measured precisely with micron-order accuracy.

PC Mouse



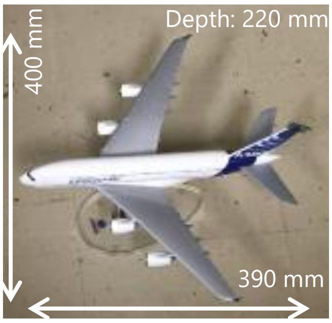
Measured Object (PC Mouse)



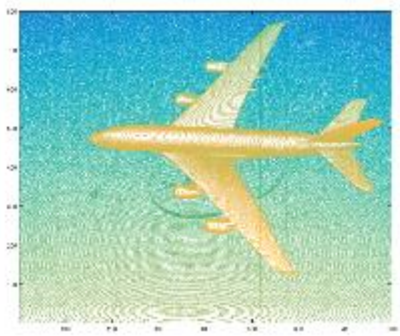
Measurement Result

This example measured the 3D shape of a PC mouse positioned 1 m from the fiber output end face. The mouse shape is measured to micron-order accuracy overall.

Model Airplane



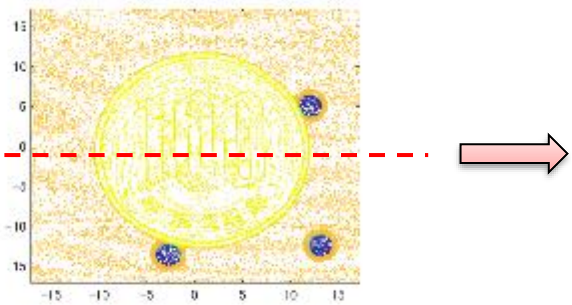
Measured Object (Model Aircraft)



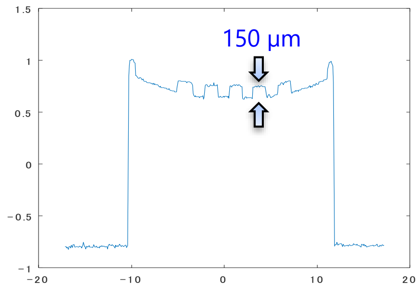
Measurement Result

This example measured the 3D shape of a model aircraft positioned 1 m from the fiber output end face. The model aircraft shape is measured to micron-order accuracy overall.

Coin



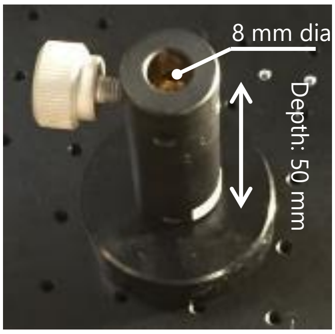
100-yen Coin Measurement Result (front face)



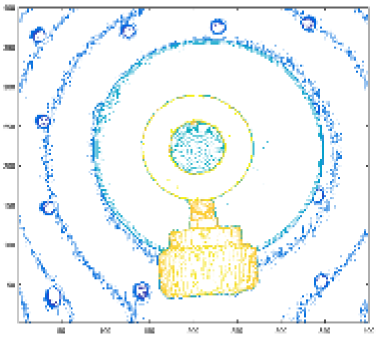
100-yen Coin Measurement Result (cross-section)

This example measured the 3D shape of a 100-yen coin positioned 1 m from the fiber output end face. The coin surface engraving was measured with high micron-order accuracy and even the coin surface curvature can be seen.

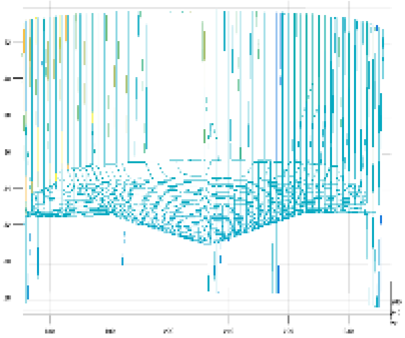
Deep Drilled Hole



Measured Object
(Drilled Deep Hole)



Measurement Result
(from top)



Measurement Result
(cross-section of hole)

This example measured the 3D shape of a deep drilled hole in an object positioned 1 m from the fiber output end face. The top face of the deep drilled object and the deep hole can both be observed with micron-order accuracy.

Anritsu Advancing beyond

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