XTOP3D Introduction

XTOP3D is dedicated to advancing 3D optical measurement technologies, developing application-oriented measurement equipment, and delivering customized technical solutions. With earlier research in the field of 3D optical measurement and inspection, a wide range of applications, mature technology and service capabilities. Many products fill the domestic gaps and have become the only supplier in China.

The series of products and technologies have served more than 500 customers around the world, and are widely used in scientific research, production and online testing of many well-known enterprises, research institutions, universities and scientific research units at home and abroad, involving consumer electronics, automobile manufacturing, heavy machinery, biomedical and other industries, covering multiple disciplines such as machinery, materials, mechanics, civil engineering and so on.

1000+
has more than 1000+ service cases and customers

100+
patented soft technology

20+
independent research and development of all series of products

15+
core personnel have more than 15 years of experience in 3D optical technology research

3D Full-Field Deformation Measurement Solutions

Expert in non-contact optical 3D full-field deformation, strain, and motion trajectory measurement

Xi'an Add: 1&2 F, Building 10, Phase II, Fengdong Free Trade Industrial Zone, Fengdong New Town, Xixian New District, Xi'an, China

Shenzhen Add：Orbbec Technology Building, No. 88 High-tech North 1st Road, Nanshan District, Shenzhen, China

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Website：www.xtop3d.cn / www.xtop3d.com

Whatapp

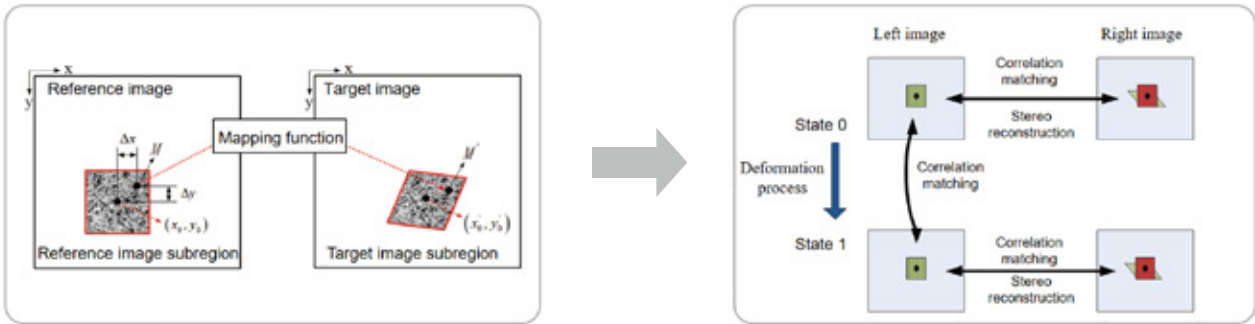# XTDIC 3D full-field deformation measurement technology

XTDIC 3D full-field deformation measurement technology, is a combination of Digital Image Correlation (DIC) technology and stereo vision technology, by tracking the speckle image or feature of the surface of the object, stereo matching and 3D reconstruction, to realize the dynamic measurement of the full-field 3D coordinates, displacement and strain of the object surface in the process of deformation, which has the characteristics of non-contact, portable, speed, high precision, easy to operate, and can be measured in real time and so on.

XTDIC technology can be used in both indoor and outdoor environments, but also in high and low temperature environments through the medium of measurement, the strain measurement range from 0.002% to over 2000%, with different image acquisition hardware, the measuring object size can be from a few millimeters squared to dozens of square meters, larger measurement area can also be customized, theoretically, in this measuring size range, as long as high quality images and characteristics can be acquired，accurate strain and deformation measurements can be carried out.

Technical principle

The basic principle of DIC (Digital Image Correlation) technology is as follows: Firstly, speckle pattern is prepared on the surface of the measured object (or the natural texture on the surface of the measured object itself), and the camera system is calibrated before the test to obtain accurate intrinsic parameters (focal length, distortion, etc.) and extrinsic parameters (spatial pose) of the camera; During the experiment, only one or more image collectors are needed to capture the surface deformation images synchronously. Finally, the XTDIC system software was used to perform stereo matching (left and right images) and time axis matching (top and bottom images) on the grid area in the speckle image to realize 3D reconstruction, deformation and strain calculation, and data post-processing analysis.

Measurement process

Camera calibration — speckle preparation on the measured object — image acquisition — matching 3D reconstruction — data report

Technical advantages

• Non-contact optical measurement system, offering a novel approach: "What you see is what you measure.";

• Full-field data measurement provides more comprehensive data than traditional point-wise measurement, and the implementation process is simple and efficient;

• Accurate time synchronization, can continuously track the same name point movement rules, especially suitable for large deformation, large displacement, high-speed movement, explosion and other scenes;

• Real-time monitoring of the whole process data, as well as providing 3D visualization of the display effect, the data at a glance, all under control;

• Manage massive data generated during engineering processes, traceable and evaluable, which can be repeatedly analyzed for different research directions to explore more data value;

• Easy expansion of third-party systems (temperature loads, mechanical loads, etc.) to perform condition-specific measurements;

• Wide range of measurement scenarios, through different media (glass, vacuum, water, etc.), can be effectively measured.

## Measurable physical quantities

• xyz coordinates (Cartesian coordinates), z-onxy (depth), radial distance, radial angle (polar coordinates);

• xyze displacement, velocity, acceleration;

• Angular displacement, angular velocity, angular acceleration, rotational speed;

• Strain ex, ey, exy, shear angle, principal strain, secondary strain, Mises strain, Tresca strain, gradient tensor, thickness reduction rate, line strain;

• Temperature field (coordinate coupling), temperature difference;

• Trajectory attitude (6-DOF);

• CAD alignment deviation;

• FEA (Finite Element Analysis) comparison deviation;

• Constructive features, points, lines, surfaces, circles, spheres, cylinders, cones, coordinate systems;

• Geometric analysis, distance (difference, rate of change), angle (difference, rate of change);

• Elastic modulus, Poisson's ratio, n-value, r-value, yield strength;

• Modal analysis, FFT analysis, ODS, OMA, UFF;

• Material forming limit, FLC, FLD;

• Crack tension displacement, COD, CTOD;

• Thermal warping, thermal expansion coefficient, CTE.
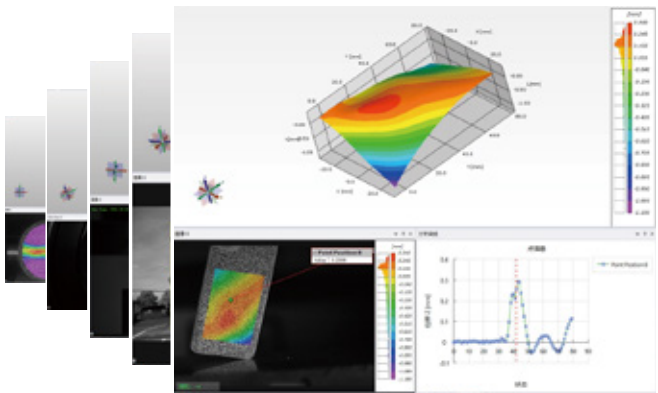
Why XTDIC

Powerful measurement performance

• Displacement resolution up to nanometer scale;

• Strain accuracy up to 20με, strain measurement range up to 0.002%~2000%;

• Sample size from a few mm² to tens of m², larger measurement field available through customization;

• Dynamic event capture rate up to 1,000,000 fps;

• Dynamic measurement real-time: full-field strain analysis 20fps, keypoint tracking 100fps@100 points, up to 1000fps.
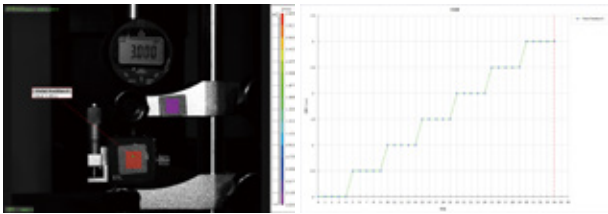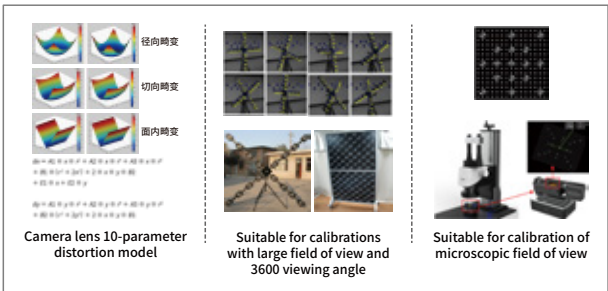
Autonomous and controllable core algorithms

Image recognition and matching algorithms

For digital speckle and coded marker, high-precision digital image correlation matching algorithm, marker center positioning and coding recognition algorithm are developed to achieve accurate positioning and matching of multiple features.

Digital Image Correlation (DIC)

Recognition of coded and non-coded markers
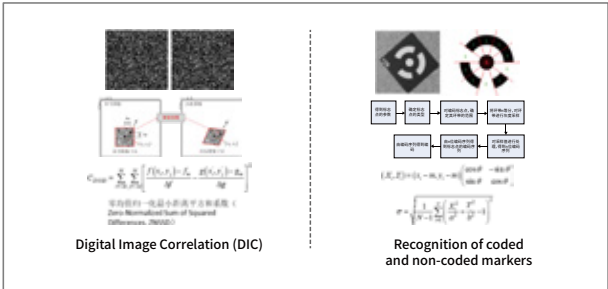
High-precision camera flexible calibration algorithm

Based on photogrammetric technology camera flexible global calibration method, complete a few millimeters to tens of meters range of single-camera, dual-camera and multi-camera calibration, which does not need to know the exact size of the calibration object in advance, and at the same time using the 10-parameter and 2F camera lens aberration model, you could accurately calibrate the conventional, ultra-short-focus, ultra-long-focus, body microscope and other optical systems.

Camera lens 10-parameter distortion model

Suitable for calibrations with large field of view and 3600 viewing angle

Suitable for calibration of microscopic field of view

High precision 3D reconstruction algorithm

Developed a photogrammetric algorithm based on single-camera multi-view angle, which can carry out accurate 3D reconstruction of key points. Meanwhile, developed a 3D reconstruction algorithm based on binocular stereo vision for dense points in the full field, which realizes the full-field big data for dynamic measurement and fast solution.

image acquisition   Speckle image

Displacement field   Strain field

3D reconstruction for binocular stereo vision

3D reconstruction with single camera close-up photogrammetry
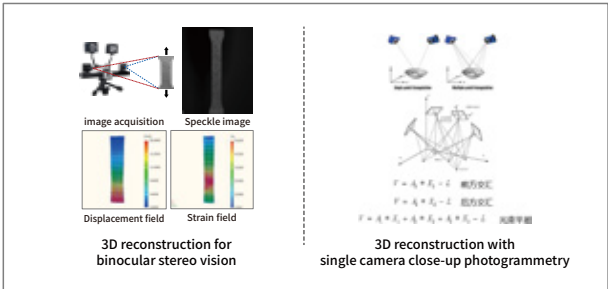
Rich data post-processing algorithms

With 18 kinds of deformation and strain calculation methods, interpolation and hole filling and data smoothing algorithms, multiple geometric element creation and distance and angle analysis functions based on the created elements, etc., together with curves and icon display, makes scientific research more efficient and convenient.

Professional DIC technology manufacturer

• Focus on DIC technology research and development, application for more than 10 years, master the core technology in the field of DIC technology, participate in a number of national key science and technology projects and national, industry standards revision;

🏆 Second prize of National Technical Invention

🏆 The first prize of Shaanxi Science and Technology Award

• Pioneer of domestic DIC technology, continuously updating and releasing DIC software and expanding supported hardware every year to enhance equipment capabilities.
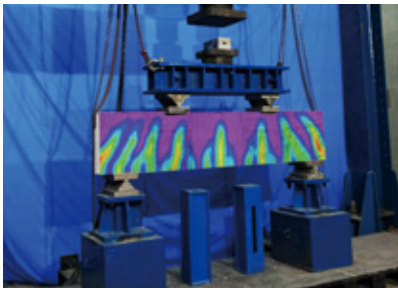

Rich industry applications
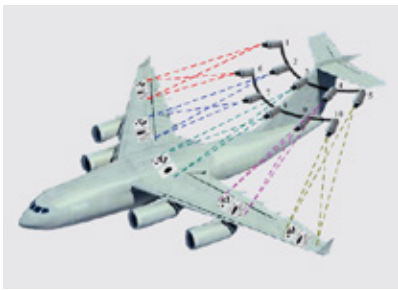
Aerospace
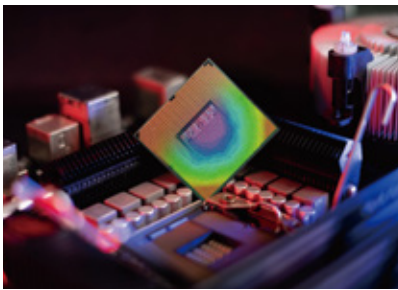
Chip semiconductor
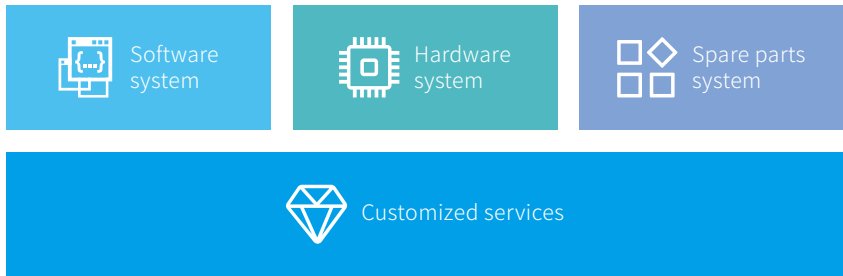
Automotive and ships

Material testing

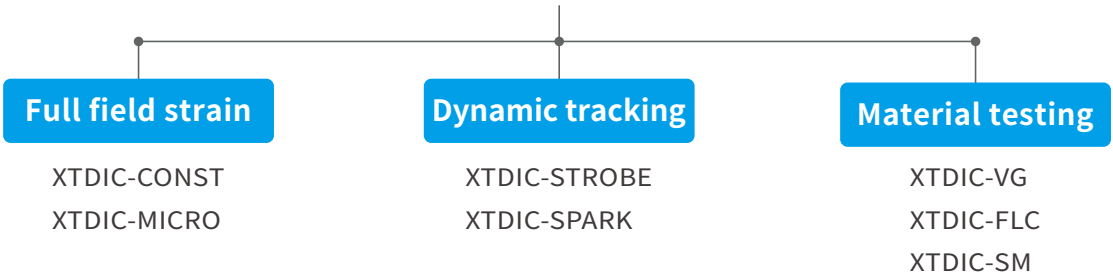Coal,rock and civil engineering

Biomedicine

Customized services

XTOP3D provides one-stop solutions, including software system, hardware system, spare parts system and other customized services.

Software system

Hardware system

Spare parts system

Customized services

XTDIC product introduction

XTDIC 3D full-field strain measurement and analysis system

Full field strain	Dynamic tracking	Material testing
XTDIC-CONST	XTDIC-STROBE	XTDIC-VG
XTDIC-MICRO	XTDIC-SPARK	XTDIC-FLC
		XTDIC-SM

Full field strain

XTDIC-CONST series

3D full-field strain measurement system

3D full-field displacement and strain measurement study (10-1000mm)

• Materials research

• Verification of simulation results

• Real-time testing and analysis of parts

• Multi-media measurement (high temperature, underwater, vacuum, etc.)

XTDIC-MICRO series

3D microstrain measurement system

Mesoscopic material mechanics research (1-10mm)

Semiconductor device CTE and strain measurement (1-10mm)

• Expansion test

• Warpage measurement

• Strain measurement
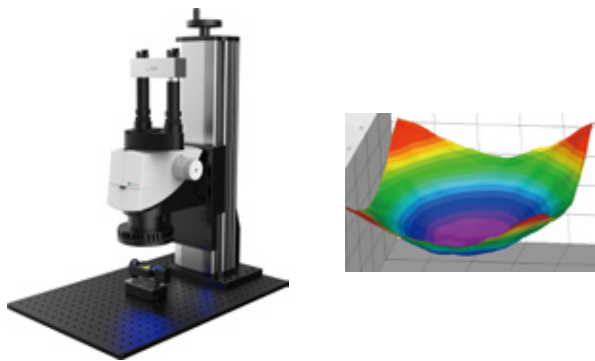
Dynamic tracking

XTDIC-STROBE series

3D dynamic measurement system

• Real-time analysis of dynamic measurements, 100fps@100 points

• 3D displacement, velocity and acceleration measurement, 6-DOF trajectory attitude tracking

• Wind tunnel testing, vehicle door vibration analysis, building vibration analysis, human motion tracking

XTDIC-SPARK series

3D high-speed measurement system

• Trajectory attitude tracking over 100m/s 6DOF

• High-speed impact, collision, vibration mode

• Subsonic and supersonic measurements

Material testing

XTDIC-VG series

Video extensometer system

Non-contact real-time strain measurement to replace the traditional strain sensor

• Material properties measurement (modulus of elasticity, Poisson's ratio, etc.)

• High speed, high temperature, fatigue, creep measurement

• Multi-position measurement, in-cavity and dielectric measurement
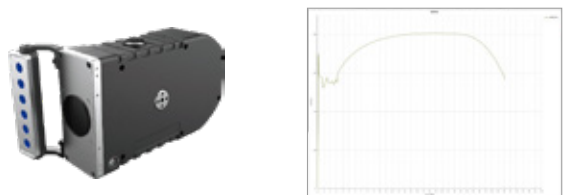
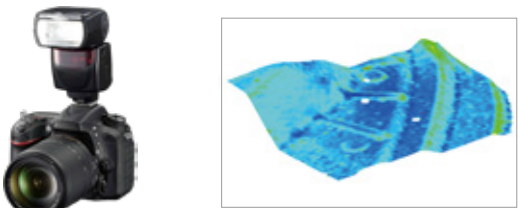### XTDIC-FLC series

Material forming limit measurement system

• Material FLC curve measurement
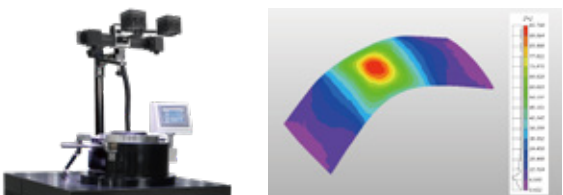
XTDIC-SM series

Sheet material strain measurement and analysis system

• Sheet forming strain measurement, failure assessment

• Stamping process optimization

Measuring probe

• Provide fixed or adjustable camera mount, stable and durable

• Integrated lighting source, beam temperature monitoring

• Integrated laser navigation for easy determination of measure-
ment position

Controller

• Various trigger functions provide accurate and diverse capture of sensitive events

• Synchronous control array system

• NS-level synchronization trigger accuracy and latency

• Multi-channel AD&DA input and output interface

Light source

Provide point light source, line light source, surface light source, etc., to meet a variety of measurement range and speed scenarios

• Constant narrowband blue light source with programmable brightness adjustment

• Narrow-band blue light synchronous pulse strobe technology, duty cycle program-
mable and adjustable

• Ultra-high power and brightness with a maximum luminous flux of 500,000 lumens

Calibrator

Multiple types of calibrators are available for different application types and fields of view

• Different precision scenes and media for aluminum, ceramic, carbon fiber

• Measuring field of view calibrators from a few millimeters to a few meters

• Micro automatic calibration module

• Calibrators are calibrated and accuracy tested

• High precision point, using nano-scale light painting process

• Metrology institute accuracy verification, traceable metrological data

Camera

Supports hundreds of industrial cameras

• Industrial cameras from several frames to millions of frames

• Camera interface: GIGE, USB3.0, 10GIGE, CXP12, etc

• Camera brands: BASLER, Baumer, FLIR, Daheng, AVT, Hikvision, Dahua, York, IX, SinceVision and other well-known domestic and foreign brands

Lens

Supports hundreds of lenses

• Regular focal length (8-75mm), ultra short focal length (1-6mm), ultra long focal length (>100mm)

FA lens, macro lens, telecentric lens, 3D lens, stereo microscope and other lenses

Adapter & Probe

• Close range common probe

• Long range reflective probe

• Hole, shaft positioning adapter

Temperature chamber

Wide range of temperature testing capabilities available to meet non-ambient temperature testing needs

• Small contact type -190-600°C / window 20mm

• Medium-sized circulating temperature chamber -40-150°C / Window 150mm

• More dimensions and temperature ranges can be customised according to the test requirements.
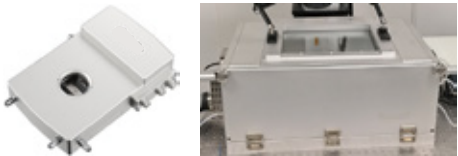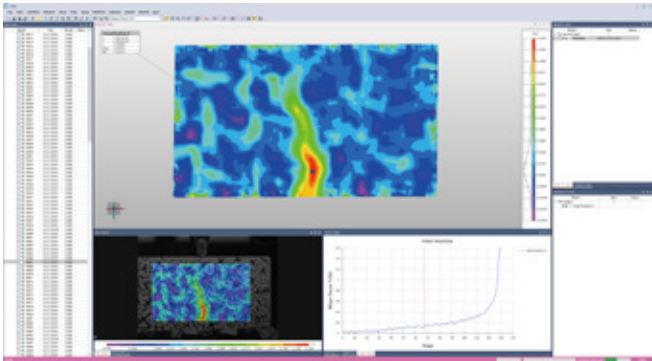
Testing machine

• Universal testing machine (tension, compression, bending, shear and torsion)

• Cupping test machine

• In-situ stretching machine

• Fatigue testing machine

• More testing machine requirements, can be customized according to test requirements

XTDIC series software

XTDIC system software adopts the concept of integration and platform development. The system integrates highly modular design functions such as image acquisition, calculation and analysis, test machine control and communication, and provides customers with professional DIC digital image related measurement data and reports. We have developed XTDIC series of functional software according to different application scenarios to meet different application scenarios.
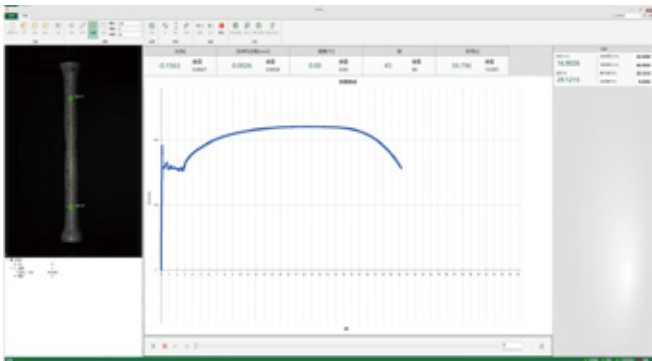
XTDIC software

• Full-field displacement and strain measurements based on speckle matching

• Motion trajectory attitude measurement based on marker detection

• Static deformation measurement based on photogrammetry techniques

• Keypoint motion trajectory measurement based on feature matching

XTDA software

• Motion measurement and analysis based on markers and feature points

• Motion parameter analysis and 6-DOF trajectory attitude measurement

• High-speed real-time multi-mode tracking computation

XTVG software

• Video extensometer

• Dynamic monitoring of full-field strain

• Determination of material constitutive parameters
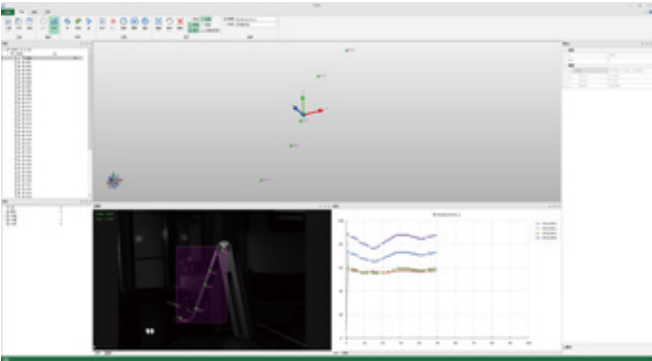
XTSM software

• Sheet metal mesh strain measurement based on corrosion mesh point identification

• FLD analysis
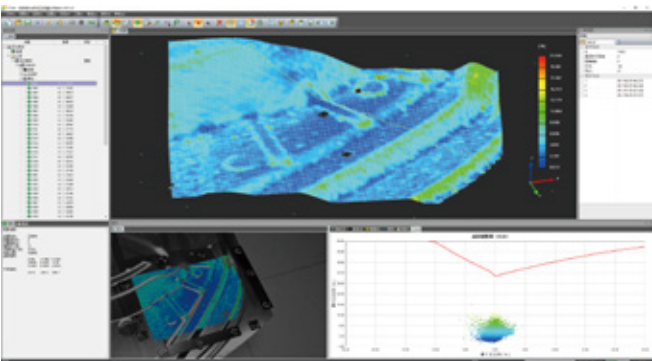
Technical Features

Multiple tracking techniques

Speckle full-field measurement, circular marker tracking, feature point tracking (cross symbol, etc.) and multi-feature composite measurement.

Flexible calculation

Online real-time calculations, automatic full-process calculations, key measurement objects, regions, time-domain frames or different processes independently calculated and combined.

Full scene calibration

Monocular, binocular and multi-ocular camera calibration can accurately calibrate conventional, ultra-short focus, ultra-long focus, stereo microscope, tunnel microscope, complex media and other optical systems.

Parametric design, big data

Different measurement blocks can be created in different areas, and different parameters can be set independently for calculation and analysis, with massive, long-time data acquisition and processing for storage.

Rich measurement data

18 strain calculation results; Displacement, velocity, acceleration, angular velocity, angular acceleration, rigid body 6-DOF solution.

Multiple measurement mode

Monocular 2D measurement, monocular 3D measurement, binocular 3D measurement, multi-camera free combination measurement and infrared temperature field camera coupling.

Native camera controls

Native integrated camera control, real-time image acquisition, support for a variety of trigger methods, accurately capture the whole process of measurement events; Support for importing external images and videos Support image-free mode (only importing 2D image points or 3D point coordinates).

Platformization &SDK, compatibility

Underlying data compatibility, function module interoperability and sharing, open SDK, can be combined to solve complex scientific problems. Compatible with hundreds of cameras, mechanics, thermal equipment.

### Powerful post-processing and analysis functions

Multiple coordinate system construction and conversion; automatic interpolation and smoothing of data, rigid displacement removal; multiple geometric element creation and distance, angle and rate analysis based on the created elements; truncation line analysis and deformation domain analysis.

As the pioneer of domestically developed DIC technology, XTOP3D continues to update and upgrade the XTDIC system every year. For some special applications and scenarios, special function modules such as digital mode comparison analysis, vibration modal analysis, probe measurement, crack trajectory measurement and so on are developed to meet the user's needs for multiple working conditions.
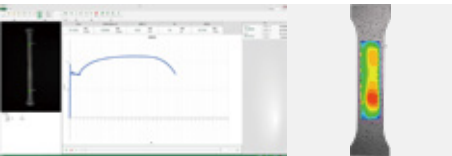

RT real-time computational analysis
• Real-time image acquisition and computation
• Real-time data monitoring and feedback control

MAT material testing and analysis
• Extensometer
• Fatigue testing
• E, μ, n, r
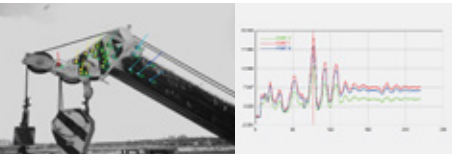
TRACK motion trajectory attitude
• Feature points motion tracking and deformation analysis
• Attitude measurement of rigid body motion trajectory

FEA finite element comparison
• Ansys, ABAQUS data alignment
• FEA data interpolation and bias comparison
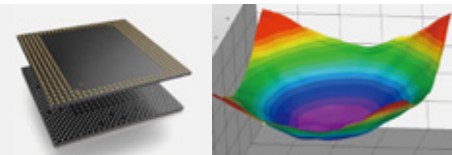
MICRO micro measurement
• Stereo microscope calibration, tunneling microscope time axis calibration
• Calibration optimization based on speckle data
• Chip micro-warpage measurement
• Rigid displacement removal

CAD analog-digital comparison analysis
• CAD digital module import (step, iges, stl)
• Automatic coordinate alignment of digital and analog models, deviation calculation
• Result-driven CAD models, digital twins
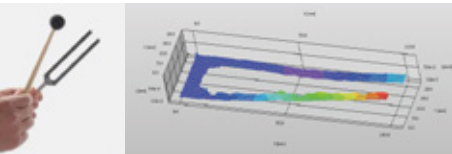
FFT vibration mode analysis
• ODS, OMA analysis
• FFT time-frequency analysis
• UFF model output
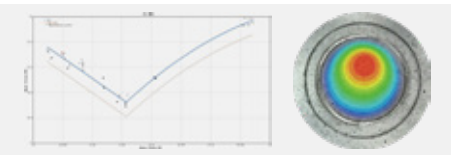
FLC moulding limit analysis
• Broken frame positioning
• FLC curve testing and generation
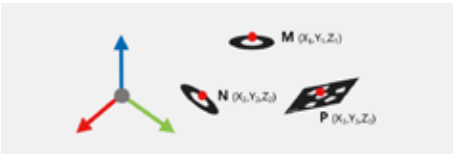• FLD failure analysis
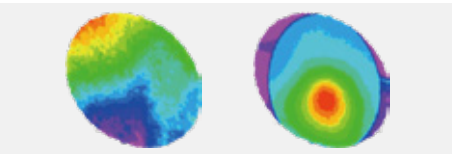
CTE thermal deformation measurement
• Infrared camera control and calibration
• Temperature field measurement and data coupling
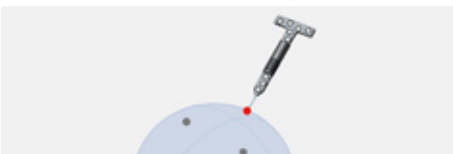• Thermal expansion coefficient measurement and analysis

DP photogrammetry
• Marker detection and identification
• Multi-view 3D reconstruction and bundle adjustment
• Static deformation measurement

COD and crack trajectory measurements
• Crack tip trajectory tracking measurement
• Crack tip opening displacement, COD/CTOD

LOC probe measurement
• Probe & adapter calibration
• Construction and measurement of lines, surfaces, holes and slots and other elements
• Coordinate system conversion and quality inspection, virtual assembly

Software module

Modules	XTDIC	XTVG	XTSM	XTDA
Basic measurement	√	√	√	√
RT	√	√		√
MAT	√	√		
TRACK	√	√		√
MICRO	√			
CAD	√		√	
FFT	√			√
FEA	√		√	
LOC	√			√
DP	√		√	
FLC	√		√	
COD	√			
CTE	√			

XTDIC-CONST series-3D full-field strain measurement system

Specifically designed for materials and components 3D profiling, displacement and strain measurements

The XTDIC-CONST system supports plane 2D and curved surface 3D deformation measurement, and is suitable for full-field strain and point-based analysis under static and dynamic loads; it has a variable measuring field of view, adapts to different rate cameras, and the test tasks are flexible and diverse , assisting scientific research institutions and universities in research testing and transformation of scientific research results.
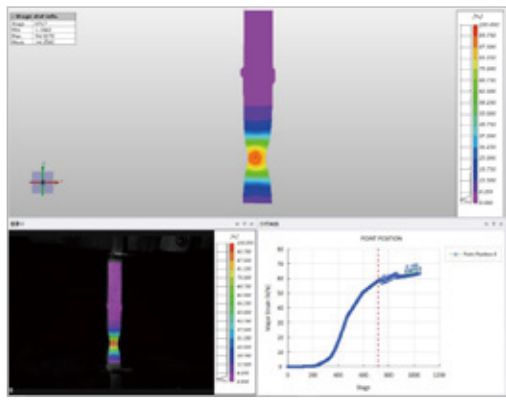
Tensile test

Technical Characteristics

- Measuring field of view 10mm~10m, support customised larger field of view
- Accuracy 20με, Range 0.005%~2000
- Maximum full frame 563 fps, maximum 2000 fps (windowingI)
- 2D and 3D coordinates, displacement, deformation, strain
- Elastic modulus, Poisson's ratio, n value, r value, yield strength
- ±10V/UDP/COM and other online testing machines, temperature chamber
- 2000°C temperature field coupling (optional)
- Multi-media environment measurement(high/low temperature/underwater/reflector/vacuum)

- Real-time mode 2-4Hz
- Velocity, acceleration
- 6-DOF trajectory pose
- Deviation ratio CAD/FEM
- CTE measurement
- Probe, adapter (optional)
- Multi-probe stereo measurement

Typical configuration

| Model	XTDIC-CONST-SD	XTDIC-CONST-HR		XTDIC-CONST-HS	
Specification	5M	12M	25M	4M	25M
Camera resolution	5 Mpx×2	12 Mpx×2	25 Mpx×2	4 Mpx×2	25 Mpx×2
Camera frame rate	75fps	30fps	15fps	563fps	90fps
Strain measurement accuracy	20με @2D、50με @3D	20με@2D、3D		50με@2D、3D	
Strain measurement range	0.005%~2000%			0.01%~2000%	
Measuring field of view	400*300mm、200*150mm 128*96mm、64*48mm Optional (supports more views)	1000*1000mm、400*300mm 200*150mm、128*96mm Optional (supports more views)		1000*1000mm、400*300mm 200*150mm、128*96mm Optional (supports more views)	

Application

Material testing

- Any material
- Young's modulus, Poisson's ratio, N value, R value
- Mechanical tests (tension, compression, bending, torsion, shear)
- Fatigue and creep tests
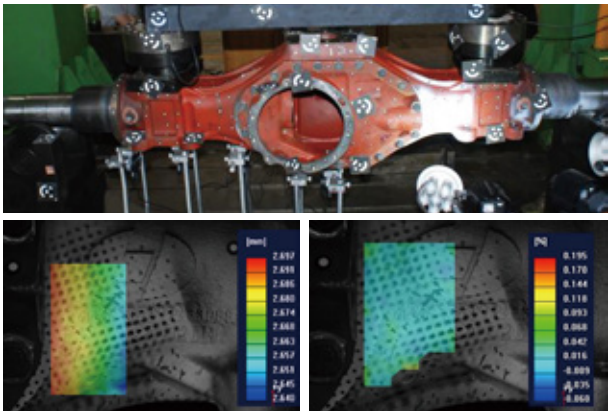- CTE testing, semiconductor device warpage
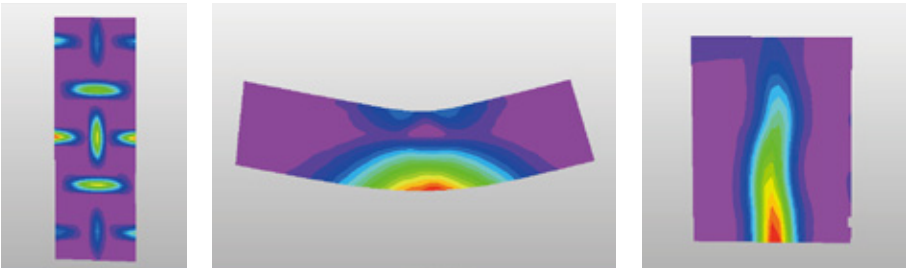
Verification of simulation results

- Complex problem discovery
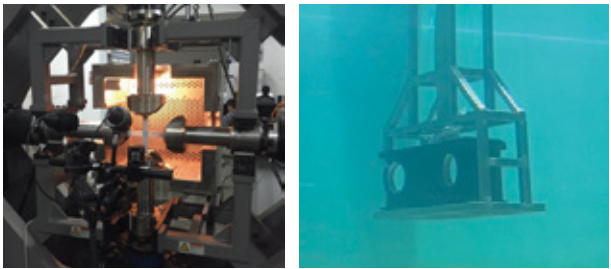- Setting of simulation parameters
- Optimization of manufacturing processes
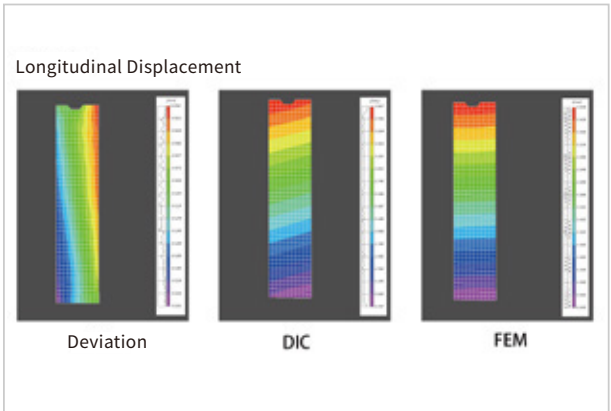
Real-time measurement and analysis of components

- Performance testing
- Quality assessment
- Guided assembly process

Longitudinal Displacement
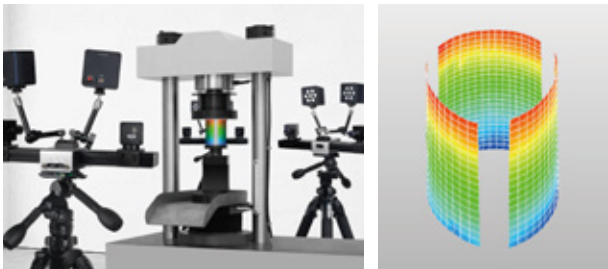
Deviation DIC FEM

Multi-media environment measurement

High temperature bi-directional tensile test   Underwater measurement test

### Stereo measurement with three probes

Three probe stereoscopic compression test

XTDIC-MICRO series-3D microscopic strain measurement system

## Microscale mechanical in-situ loading with DIC measurement solutions

XTDIC-MICRO 3D microstrain measurement system combines the stereo microscope and DIC technology to make up for the shortcomings of traditional 3D measurement that cannot measure the deformation of tiny objects, and the accuracy is as high as nm level. The system can be combined with the mechanical/thermal testing machine to provide a powerful measurement tool for the mechanical properties and thermodynamic research of micro materials size of 1~10mm.
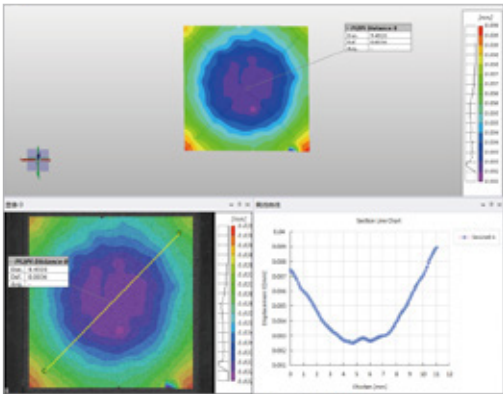
Chip thermal warpage measurement test

Technical Features

- Measuring field of view 1~ 10mm
- Chip warpage accuracy 0.1um
- Multiple strain tensors
- Fog suppression technology
- Microscopic speckle technique
- Material parameter determination CTE
- Thermal airflow suppression technology
- Mechanical testing of micro materials, testing machine(5000 N)

- Rigid displacement elimination technology
- 2D and 3D coordinates, displacement, deformation
- Accuracy up to 20µε, ranging from 0.005% to 500%
- High precision photolithography calibration element
- Automatic microscopic calibration technology
- Thermal research, temperature chamber (-190 ~ 600°C)
- Elastic modulus, Poisson's ratio, n value, r value, yield strength
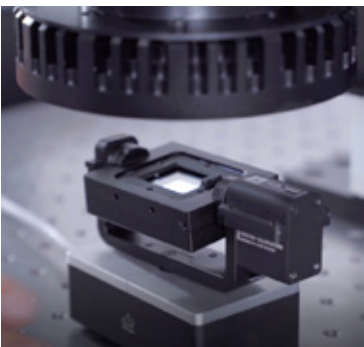
Microscopic automatic calibration device

Typical configuration

| Model	XTDIC-MICRO-SD	XTDIC-MICRO-SR	XTDIC-MICRO-HR
Specification	5M	5M	12M
Camera resolution	5 Mpx×2	5 Mpx×2	12 Mpx×2
Camera frame rate	75fps	75fps	30fps
Strain measurement accuracy	30µε	30µε	20µε
Strain measurement range	0.005%~500%	0.005%~500%	0.005%~500%
Measure field of view	2mm~10mm	1mm~10mm	1.5mm~13mm
Work distance	83.4mm	61.5mm	61.5mm
Total magnification	0.6x~4.8x	0.64x~8x	0.64x~8x

Application

Chip thermal warpage

- 0.1um warpage accuracy
- 3D numeric display warpage

6.3*6.3mm，12Mpx，30Hz Warpage 3D display under different temperatures 0°C-100°C warpage 7um, morphology symmetry
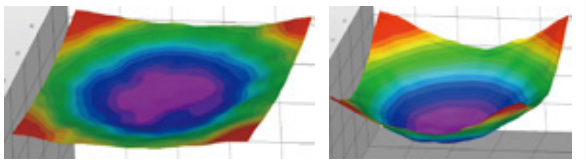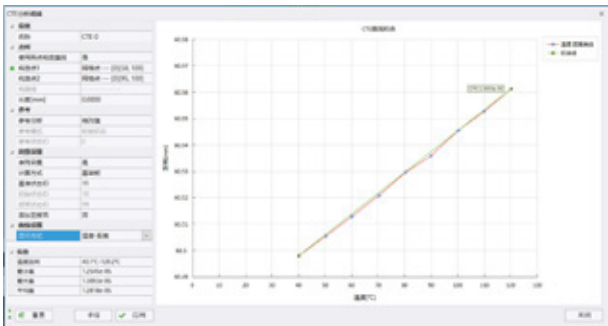

Material testing

- Constant temperature stretching of the metal films
- Young's modulus, Poisson's ratio, etc
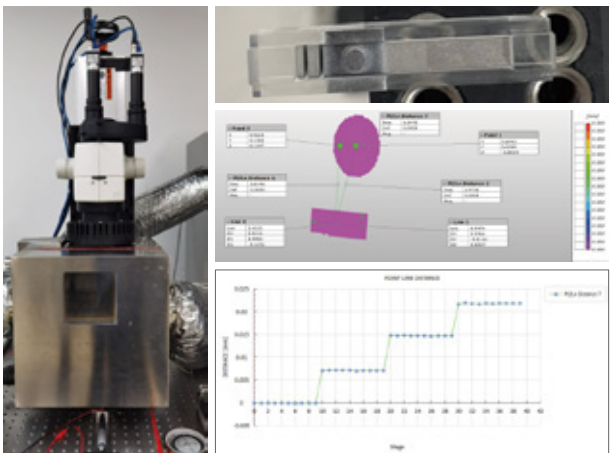- Failure analysis

Measurement of CTE parameters

- Material CTE determination
- Packaging technology
- Anisotropy
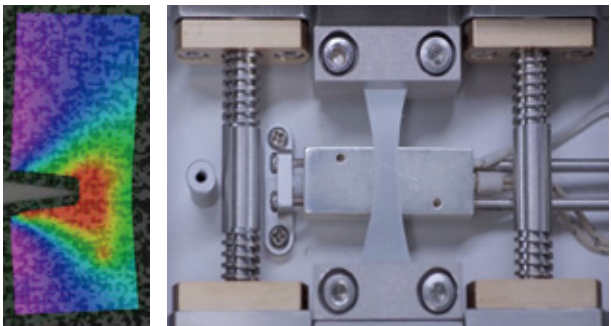
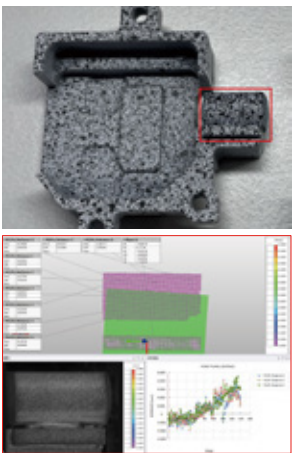Constant temperature stretching of metal film

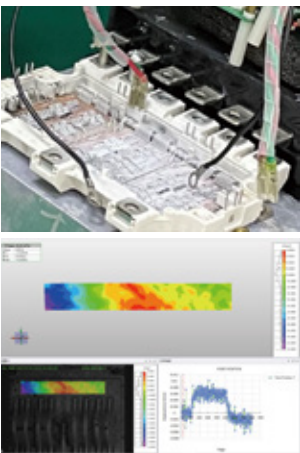### Design verification and process improvement

- Thermal displacement of optical axis and lens
- Thermal displacement of fiber core
- Thermal deformation of components in working state

Thermal displacement test of optical axis and lens

Thermal displacement test of fiber core

Thermal deformation test of components in working state

XTDIC-STROBE series-3D dynamic measurement system

Non-contact full-field 3D coordinate, displacement and deformation measurements

XTDIC-STROBE 3D dynamic measurement system is based on stereo vision technology and image feature recognition technology. It can realize deformation measurement, displacement tracking, and trajectory measurement at different speeds, and output key point velocity and acceleration data for studying and analyzing the motion process. XTDIC-STROBE has the features of solid structure, stable process and simple operation, and is widely used in industry and scientific research.
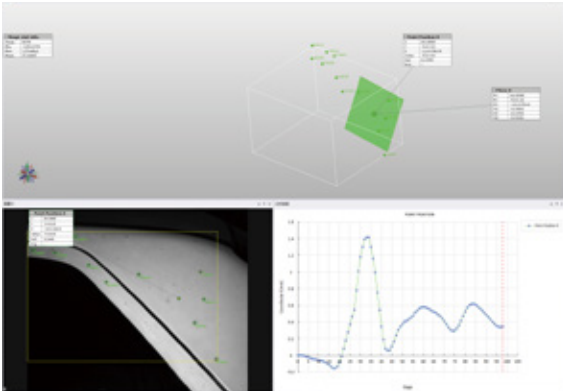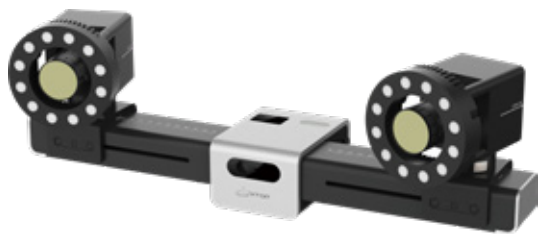
Door opening/closing test

Technical Features

• Real-time tracking measurement and data output up to 1000fps

• 3D coordinates, displacement and deformation measurements

• Manual, semi-automatic and fully automatic tracking

• XY/XT/ multi-axis multi-window chart, 3D trajectory display

• Feature tracking and matching algorithms supports any pattern (markers, code points, crosses, etc.)

• μs level high-speed synchronous light source and reflector technology (reflector + coaxial light)

• Extremely fast acquisition technology, multiple synchronous acquisition technologies

• Phase-locked loop technology, especially suitable for circular motion tracking, can track subsonic targets

• Up to 4500fps@30 million

• Tracking accuracy 0.005px

• Simultaneous tracking of massive targets

• Velocity and acceleration measurements

• 6-DOF trajectory attitude measurement

• Sturdy structure, fast on-site measurement tasks

Marker Points   Coded Points   Cross Marks   Natural Textures
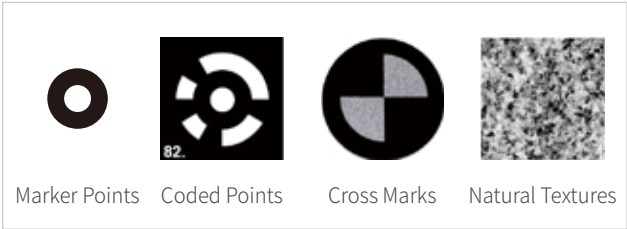
Typical configuration

Model	XTDIC-STROBE-SD	XTDIC-STROBE-HR	XTDIC-STROBE-HS	
Specification	5M	12M	4M	2.5M
Camera resolution	5 Mpx×2	12 Mpx×2	4 Mpx×2	25 Mpx×2
Camera frame rate	75fps	30fps	563fps	600fps
Displacement measurement accuracy	0.005px			
Measuring field of view	100mm-10m, optional (supports more views)			
Real-time tracking	≥100fps@100, up to 1000fps			

Application

### Wind tunnel multi-measuringprobe open rotor testing

• Dual measuring probe rotor angle measurement (wingtip to subsonic speed)

• Using phase-locked loop phase shift splicing to complete the cycle
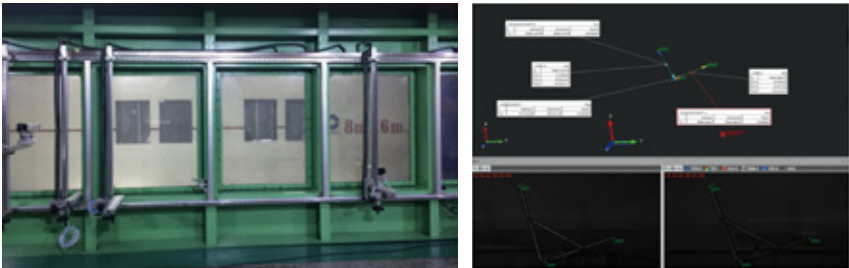
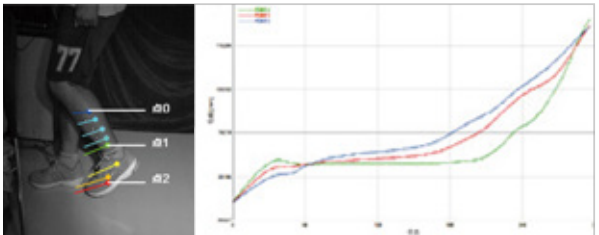Wind tunnel model motion attitude measurement test

Automotive

• Deformation, velocity, acceleration

• Door closing test

• Hood closure test

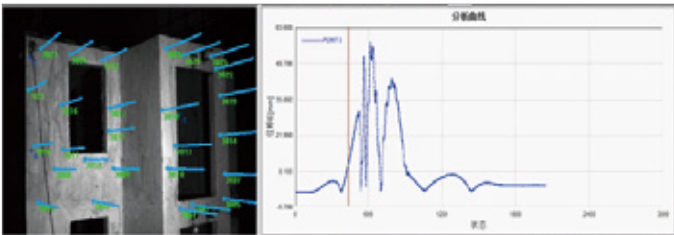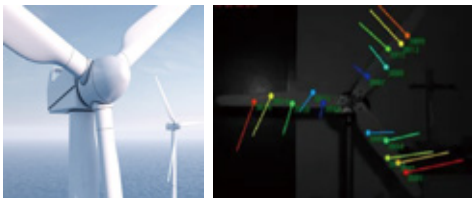• Wind tunnel dynamic behavior testing
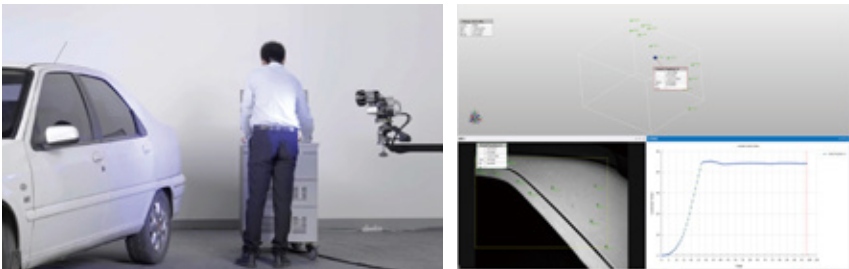
Door closing test

Human motion tracking

Civil engineering - earthquake simulation

Wind turbine blades

Rail crossing detection

Bridge monitoring

XTDIC-SPARK series-3D high-speed measurement system

High-speed/ultra-high-speed non-contact full-field coordinate, displacement, deformation, strain measurement

XTDIC-SPARK 3D high-speed measurement system can directly control high-speed camera acquisition, or import image sequences or videos from the outside, and calculate the displacement, velocity, acceleration and other data of the tracking point through reference points and timing information. Based on the time panel, the system can present all the state data of the target, including data tables, curves, 3D trajectories and attitudes, etc. XTDIC-SPARK system is particularly suitable for high-speed tracking measurement, and can synchronously record external loading or displacement data information frame by frame, realizing non-contact full-field dynamic strain measurement for extreme tests such as high-speed or ultra-high-speed.

Blade high-speed rotation test

Technical Features

- Ultra-high speed measurements of over 1 million frames
- Tracking accuracy up to 0.01px
- Simultaneous tracking of massive targets
- Support multiple format image or video import calculation (AVI, TIFF, BMP, JPEG, MPEG2, CINE, etc.)
- Flexible multi-camera combination measurement
- Image preprocessing

Feature tracking and matching tracking algorithms (markers, coded points, crosses, etc.)

- Manual, semi-automatic and fully automatic tracking
- XY/XT/ multi-axis multi-window chart, 3D trajectory display

- 2D and 3D coordinates, displacement, deformation, strain
- Angle, velocity, acceleration
- 6-DOF trajectory attitude
- Deviation comparison CAD/FEM
- Material mechanics experiments (impact, collision, modal, etc.)

Marker Points   Coded Points   Cross Marks   Natural Textures
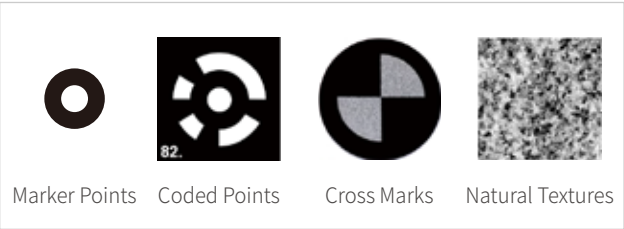
Typical configuration

| Model	XTDIC-SPARK-SD	XTDIC-SPARK-SR	XTDIC-SPARK-HR	XTDIC-SPARK-US	XTDIC-SPARK-UR
Specification	1.3M	2M	5M	1.0M	21M
Full frame rate	1.3 Mpx×2	2 Mpx×2	5 Mpx×2	1 Mpx×2	21 Mpx×2
Camera frame rate	1000fps	3200fps	4500fps	20000fps	1000fps
Minimum exposure time	100ns	100ns	1us	100ns	1us
Strain measurement accuracy	50με	50με	30με	50με	20με
Displacement measurement accuracy	0.01px	0.01px	0.01px	0.01px	0.01px
Memory capacity	16/32/64/128G Customizable real-time writing to SSD	16/32/64/256G/512G Customizable real-time writing to SSD	40/80/160/320G Customizable real-time writing to SSD	40/80/160/320G Customizable real-time writing to SSD	40/80/160/320G Customizable real-time writing to SSD

Application

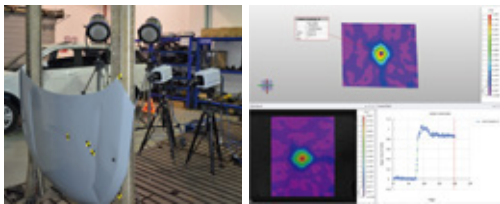### Material property test

- Impact test (Hopkinson)
- Projectile impact
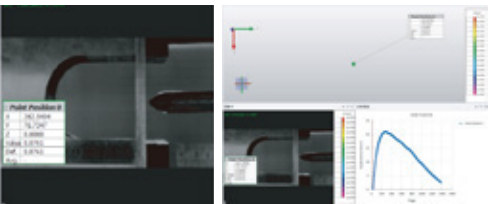- Transient vibration of tail jet ignition
- Vibration mode under wing load
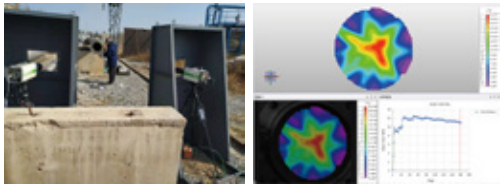
Explosion impact test
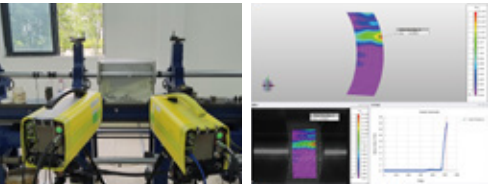
Hopkinson bar impact test

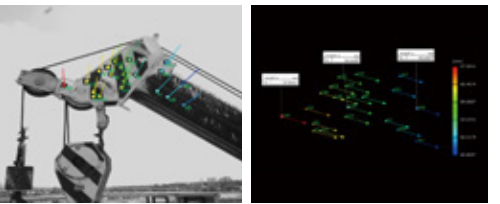Automobile cover plate high-speed collision test

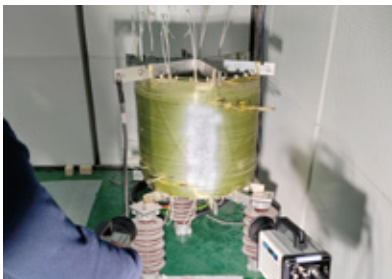Armor-piercing projectile test

Trajectory attitude tracking

- Automobile collision process testing
- Ballistic trajectory attitude 6DoF
- High-speed wind tunnel test
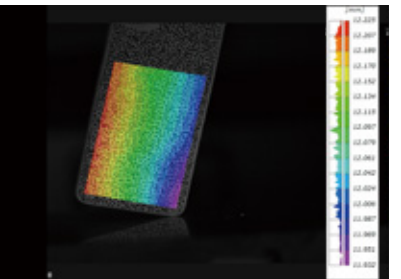- Drop test

Aircraft seat deformation test

Crane arm swing test

Vibration test of high speed transformer


Wind tunnel test of helicopter rotor

Mobile phone drop test

XTDIC-VG series-Video extensometer system

High precision, non-contact visual strain measurement instrument

XTDIC-VG video extensionometer is a non-contact real-time strain measurement system. Based on digital image correlation (DIC) method, by capturing continuous images of the sample in the loading process, real-time tracking of the marked object, calculate the coordinates, displacement, strain and other types of data of the targets, output the measurement results, and generate a work report.

The XTDIC-VG video extensometer can communicate data with the testing machine equipment. It is a replacement and upgrade of the electronic extensometer, and is the ideal solution for special working conditions, especially in the analysis of high-temperature material properties.
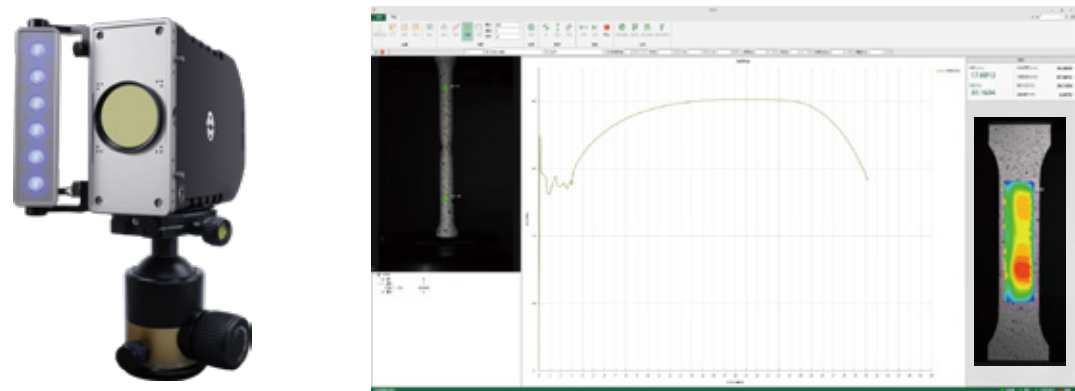
Bar fatigue test

Technical Features

• Non-contact, no need to worry about damage to the equipment caused by sample breakage
• Monocular 2.5D, monocular 3D, binocular 3D extensionmeter measurement
• Maximum measurement accuracy can reach 0.2 level @ metrology specification JJG 762
• Single-axis, dual-axis high-precision extensometer, 10-1000mm multiple fields of view
• Real-time measurement rates up to 1000fps, suitable for stretching rates up to 7200mm/min
• Multi-station measurement, in-cavity measurement, media-isolated measurement
• 2D supports oblique measurement and reserves more operation space, especially suitable for automation scenarios

• Average value extensometer
• Support online various testing machines
• Point/point pair/full-field deformation measurement
• Deformation/strain/strain rate/maximum strain measurement
• Rich data presentation: camera views, curves,tables, reports
• High speed, high temperature, fatigue, creep measurement
• Material properties measurement (elastic modulus, Poisson's ratio, etc.)

Typical configuration

Model	XTDIC-VG-60/T	XTDIC-VG-120/T			XTDIC-VG-240/T	
Specification	2.3M	2.3M	8.9M	12M	8.9M	12M
Camera resolution	2.3 Mpx×1 or 2	2.3 Mpx×1 or 2	8.9 Mpx×1 or 2	12 Mpx×1 or 2	8.9 Mpx×1 or 2	12 Mpx×1 or 2
Camera frame rate	168fps	168fps	32fps	30fps	32fps	30fps
Accuracy level	0.2 class	0.2 class	0.2 class	0.2 class	0.5 class	0.5 class
Strain measurement range	0.002%~2000%	0.002%~2000%	0.002%~2000%	0.002%~2000%	0.002%~2000%	0.002%~2000%
Measuring field of view	60mm	120mm	120mm	120mm	240mm	240mm
Working distance	300mm	270mm	200mm	200mm	400mm	400mm
Others	Customizable (supports more fields of views)					

Note: with T for binocular 3D video extensometer

Application

Material performance testing

• Any material, especially suitable for small, flexible, high temperature scenes
• Average value extensionometer, more accurate material parameters
• Automatic recognition of peaks and valleys, better suited for long fatigue cycles

Source: Kawahara
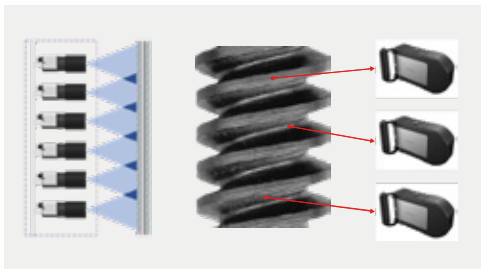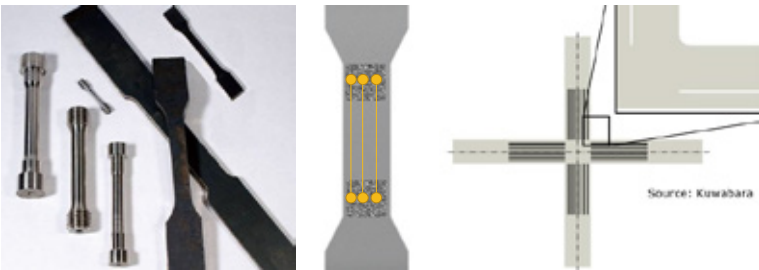
Large field of view multi-probe splicing solution

• Suitable for material length over 600mm and large field of view measurement requirements
• Develop multi-probe splicing overall error elimination technologyAccuracy can reach 0.5 video extensometer standard
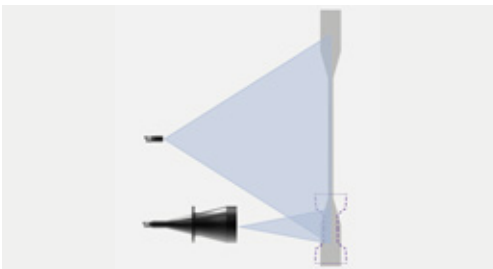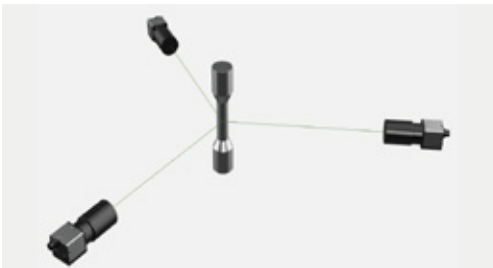
Dual range measuring probe combination solution

• Suitable for stretching high-plastic materials such as rubber, gel, polymer materials, carbon fiber, etc.
• In the low-strain stage, configure independent camera and telecentric lens to improve measurement accuracy
• During the large deformation stage, another independent camera and standard lens are equipped to record the whole deformation process of the material
• Non-destructive splicing of the two measurement phases through feature splicing enables simultaneous low-strain high-precision measurements and full-field unification of large deformations in a single measurement.

Multi-station simultaneous stretching solution

• Suitable for simultaneous stretching test of multiple samples in the same batch
• Independent hardware for each channel
• Unified data display for easy comparison

3600 combination solution for rod-shaped profile stretching

• The three measuring probes are evenly distributed in the same horizontal plane, independently perform 2D acquisition and analysis, and calculate the average tensile strain, resulting in more accurate results.
• The three measuring probes are evenly distributed in the same horizontal plane and used in combination to analyze the material necking state and changes in cross-sectional parameters during the stretching process of rod-shaped profiles, such as the major axis, minor axis, roundness, etc. of the cross-section ellipse.

XTDIC-FLC series-3D sheet metal forming limit measurement system

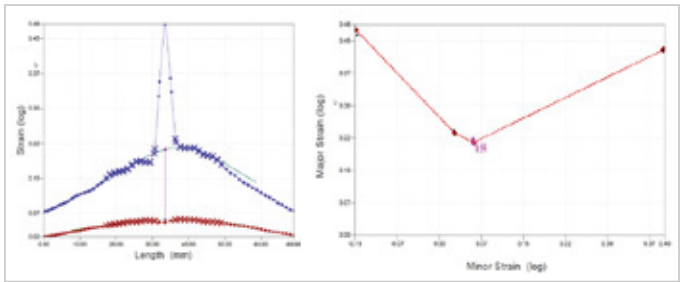## Determination of molding limit curve of FLC material

XTDIC-FLC is a measurement system based on digital image correlation technology, used in conjunction with sheet forming and cupping testers. The system automatically collects a sequence of video images of sheet deformation when the cupping tester is working, and directly obtains the limit strain based on grid strain analysis, digital image correlation measurement and other technologies to generate the limit curve FLC. It is an indispensable tool for determining the material forming limit curve.
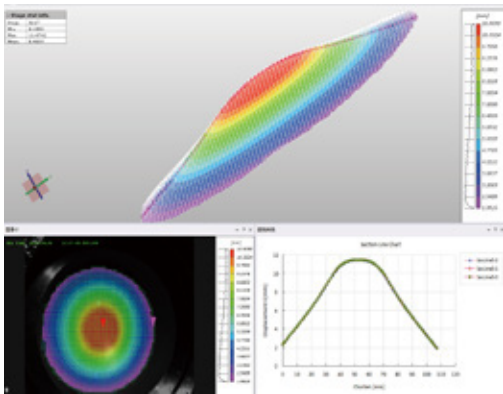
SPCC sheet forming limit determination test

Technical Features

- 3D coordinates, displacement and strain data of the part surface
- Time correlation method and position correlation method accurately obtain limit points
- Automatic identification of fracture frames
- FLC curve, and support for FLD data import and display
- High-definition pdf report
- GB/T 24171 ISO 12004
- Supports conventional and high temperature measurements
- Special bracket, and quick combination with testing machine
- Combined with the FLD module, the stamping process can be evaluated in the production process.
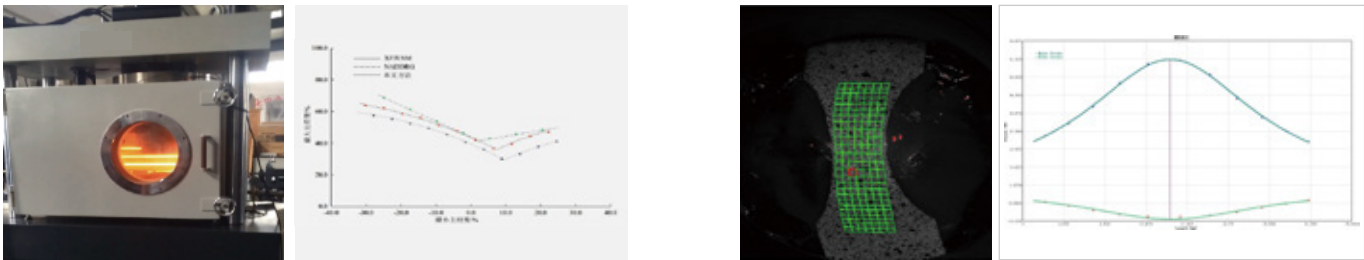

FLC curve drawing

Application

GB/T 24171 Test for determination of forming limit curve of metal materials
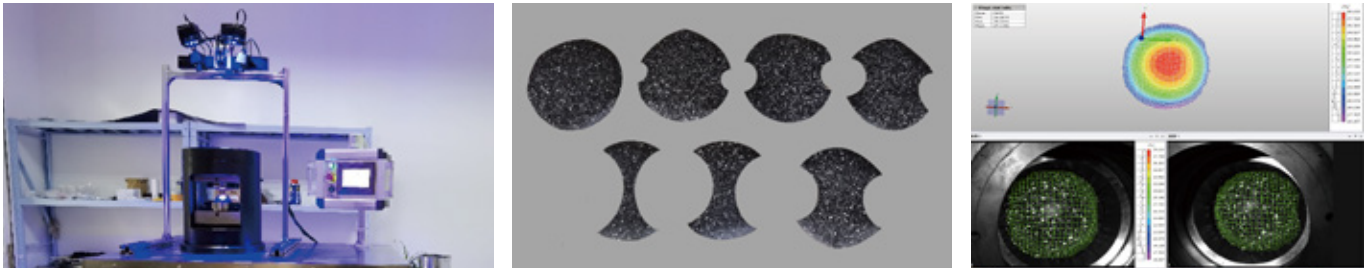
Test for forming performance of thin film sheet
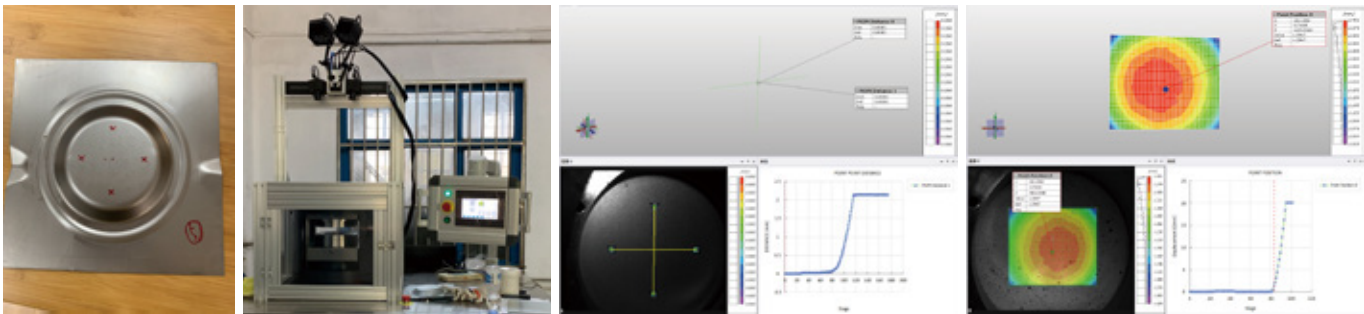
Test for forming limit of sheet

Test for forming high strength sheet at high temperature (900℃)

Cupping test

Typical configuration

Model	XTDIC-FLC-EC4	XTDIC-FLC-EC6	XTDIC-FLC-EC6-HT	XTDIC-FLC-EC20
Specification	5M	5M	5M	5M
Camera resolution	5 Mpx×2	5 Mpx×2	5 Mpx×2	5 Mpx×2
Camera frame rate	75fps	75 fps	75 fps	75 fps
Strain measurement accuracy	50με	50με	50με	50με
Strain measurement range	0.005%~500%	0.005%~500%	0.005%~500%	0.005%~500%
Measuring field of view	Standard：200*150mm、128*96mm、64*48mm			
Test force	400KN	600KN	600KN、650℃	2000KN

# XTDIC-SM series-Sheet metal forming strain measurement system

Strain measurement and analysis of sheet metal stamping

The XTDIC-SM system obtains the 3D coordinates of each round point on the sheet surface through photogrammetry, aligns the grid points with the same name before and after stamping, and calculates the strain data of the grid points; by importing FLC curves and comparing the distribution of the main and secondary strain data of the parts and outputting FLD diagrams, it can quickly locate the critical position, and it is an intuitive and highly efficient measurement tool for evaluating the process of stamping and moulding.

Technical Features

• 3D coordinates and strain data of parts surface
• FLD forming limit diagram to evaluate forming quality
• Thickness reduction rate measurement
• Intuitive display of critical deformation position
• Provide comparison between simulation results and measurement data
• Special grid spotting tool, stable and efficient
• Automatic grid alignment
• Realize block measurement and splicing, multi-state detection
• Support Wi-fi wireless image transmission and multi-format image import calculation
• Using industrial measurement cameras to achieve higher measurement accuracy grid speckle
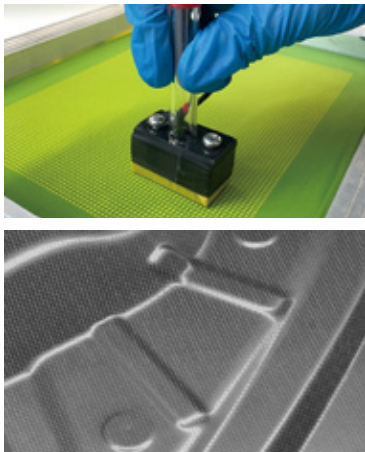
Grid based spot making

Typical configuration

| Model	XTDIC-SM-SD	XTDIC-SM-SR	
Specification	24M	12M	31M
Camera resolution	24 Mpx×1	12 Mpx×1	31 Mpx×1
Camera type	Single-lens reflex camera	Industrial camera	Industrial measurement camera (wireless transmission)
Strain measurement accuracy	0.10%	0.05%	0.05%
Strain measurement range	0.5%~300%	0.2%~300%	0.2%~300%
Light source	Split photography flash	Integrated narrowband LED light source	Integrated narrowband LED light source
Measuring field of view	100mm~10m		

Application

• Key location analysis
• New material development
• Raw material inspection and quality control
• Solving complex molding problems

Material testing and simulation results verification
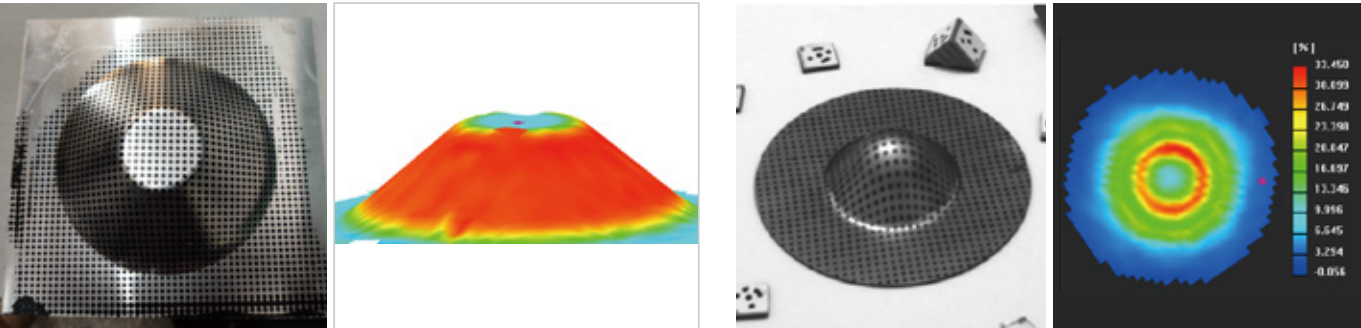
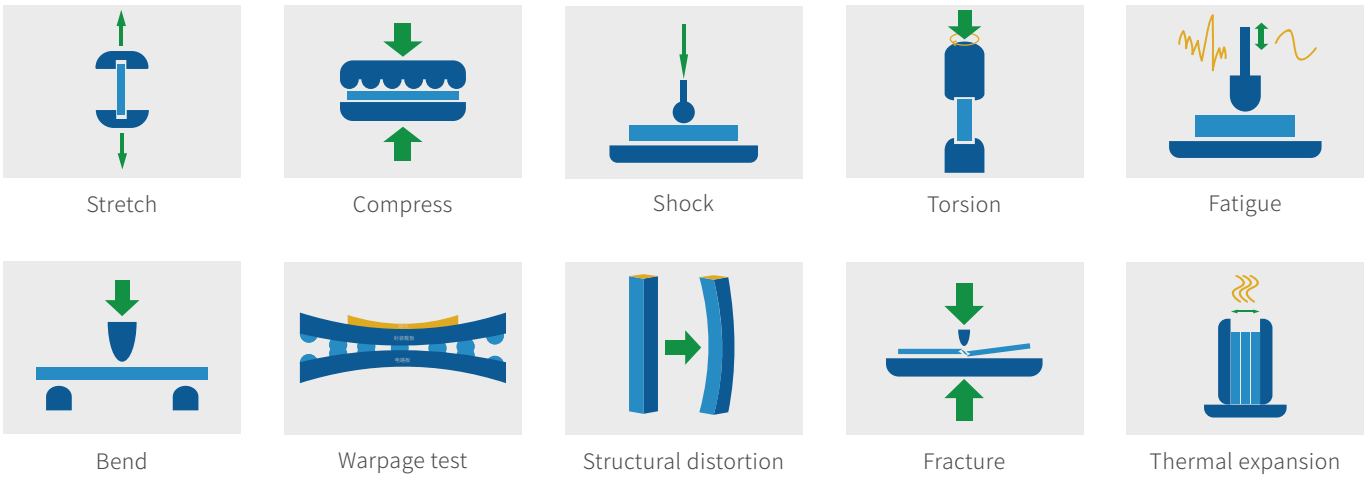**Sheet metal parts, stamping parts testing**
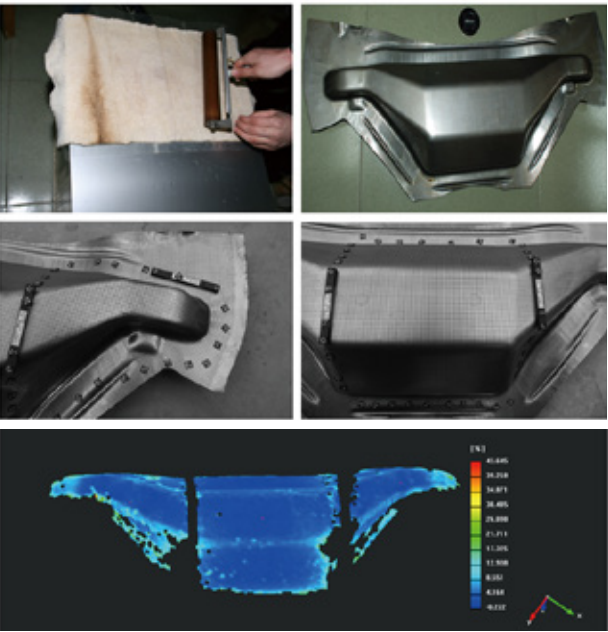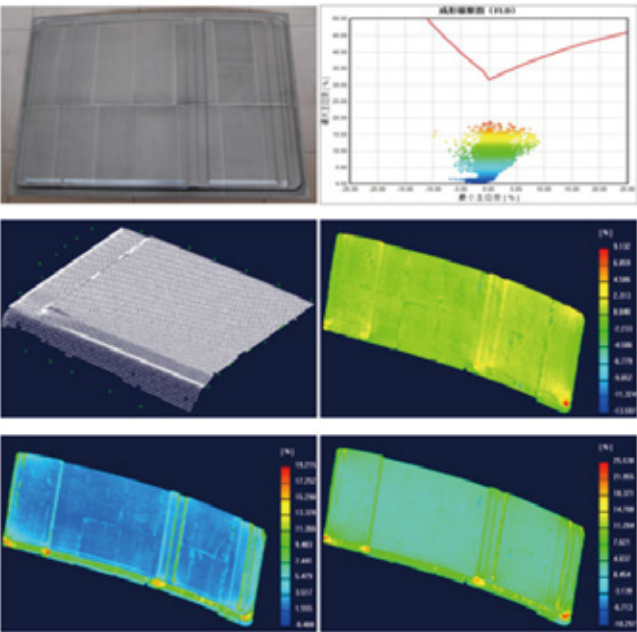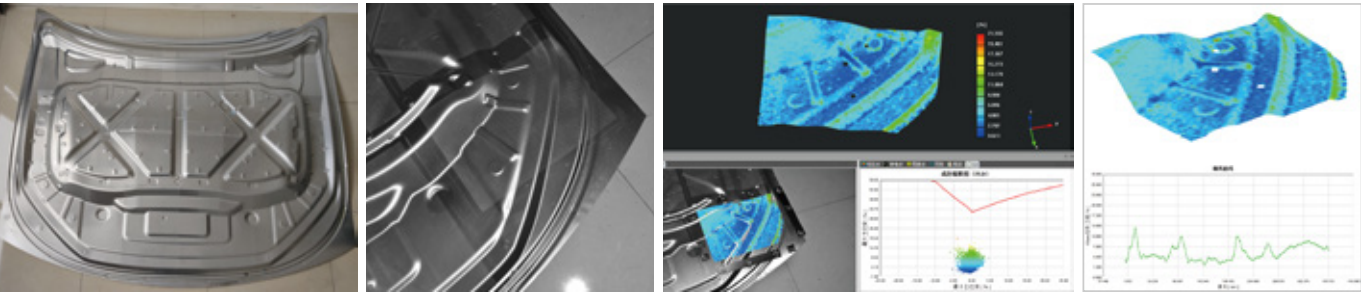
Material testing

Covering multiple sizes and different material mechanical property testing experimental scenarios

The XTDIC 3D full-field strain measurement and analysis system significantly improves the accuracy of measuring the mechanical properties of materials. It can replace the traditional extensometer and strain gauges to achieve material surface deformation analysis, and is widely recognised and praised in the industry as the 3D strain measurement solution.
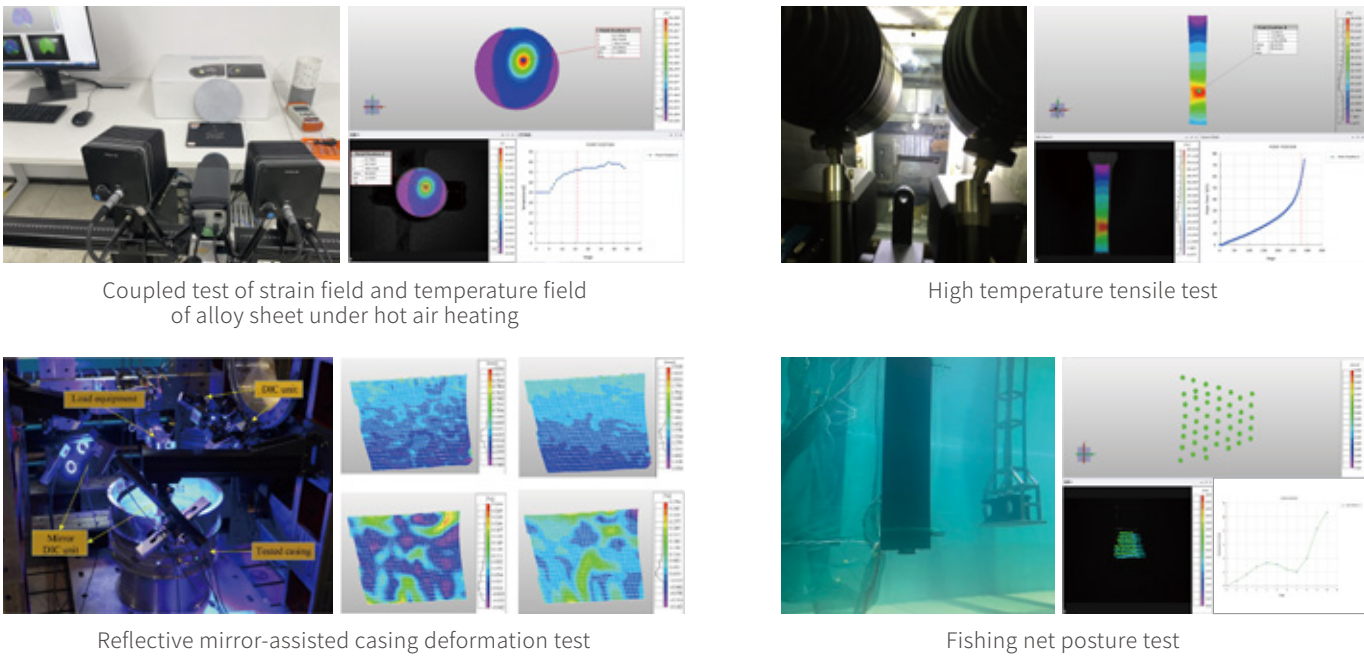
Any material test

The XTDIC system can analyze the mechanical properties and behavior of materials with different sizes and materials in various complex testing environments, making conventional mechanical property tests more reliable.

Stretch	Compress	Shock	Torsion	Fatigue
Bend	Warpage test	Structural distortion	Fracture	Thermal expansion

Tensile test

Bending test

Compression test

Shear test

Multi-media environment measurement (high/low temperature/underwater/reflector/vacuum)

The XTDIC system can integrate various types of test equipment (test benches, infrared cameras, environmental chambers, etc.) and testing machines to measure the full-field 3D strain and deformation of a materials under mechanical or thermal loading, using a non-contact measuring probe.

Coupled test of strain field and temperature field of alloy sheet under hot air heating

High temperature tensile test

Reflective mirror-assisted casing deformation test

Fishing net posture test

Fatigue, creep, high speed, Stereoscopic test

Different DIC functions and modules have been developed to meet the needs of fatigue, creep, high speed, and multi-measurement head three-dimensional tests to meet the measurement requirements of different working conditions.

Fatigue test

Multi-measurement head concrete compression test

Hopkinson bar impact test
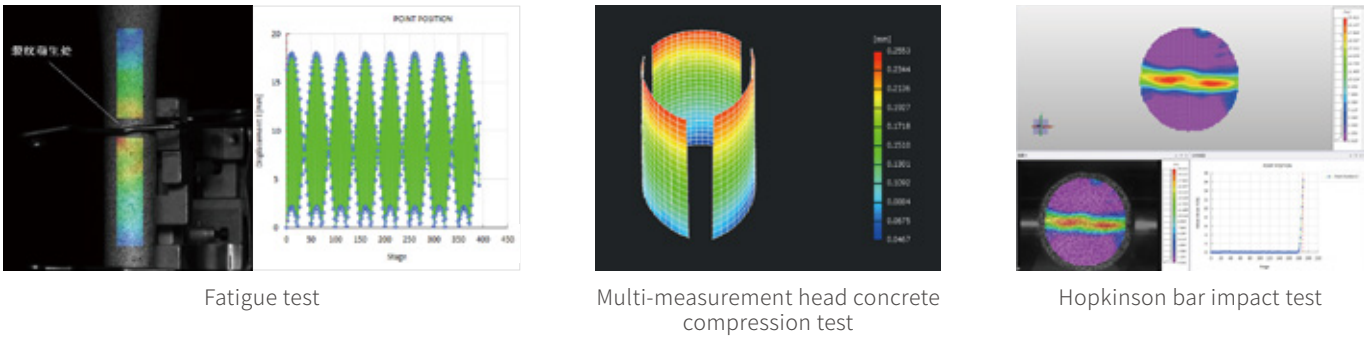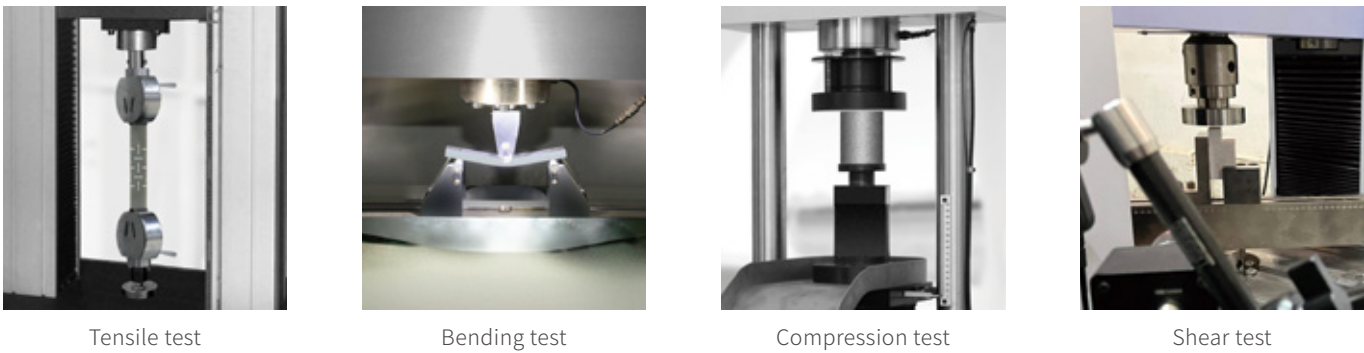
Aerospace

From material mechanics to component performance analysis, escort flying dreams

Aerospace products are one of the most complex high-tech products manufactured by human beings, They have strict requirements on appearance, numerous product configurations, different materials and shapes of parts, and complex internal structures.

The XTDIC system provides the aerospace industry with a variety of solutions such as material testing, component structure and shape deformation testing, and motion trajectory tracking testing, facilitating the digital transformation of aerospace R&D and manufacturing industries.

Parts connection test and analysis

Parts are often connected by welding, articulation, riveting and other means. The deformation of the joints is related to whether the loads of the various components of the parts can be effectively transmitted, which is the key link to ensure the structural performance of the part, and is an important part of aircraft stability and safety testing.
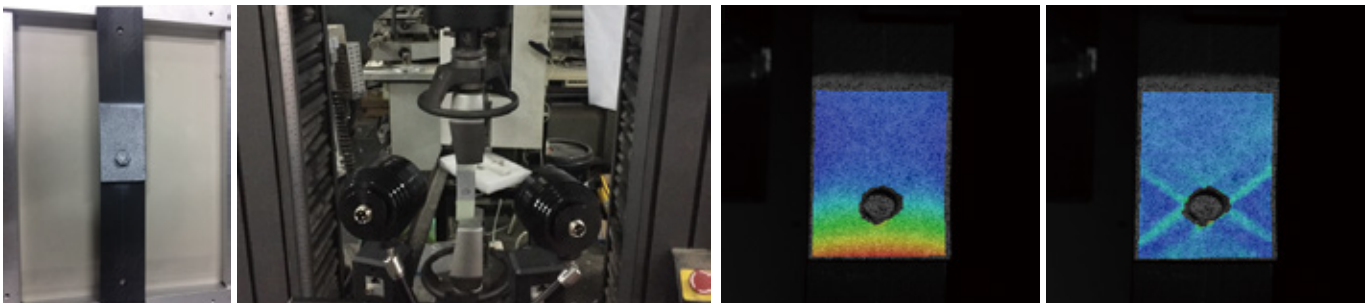
Failure mechanism analysis of riveted joints

Component and structural testing

Component and structural testing is an important part of aircraft stability and safety testing. Common tests include: deformation measurement of wings, flaps, etc., deformation measurement of parts (seat, turbine, etc.), structural testing of fuselage shell, vibration testing, etc.
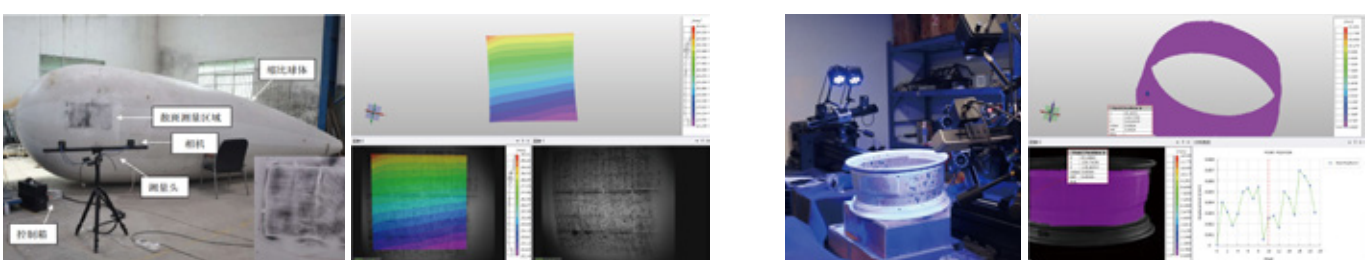
Whole machine skin test

Multi-measuring probe aerospace turbine components strain test

Aerospace equipment components are often accompanied by deformation phenomenon due to complex working conditions, the measurement of deformation distribution and deformation process has both scientific significance and application value, and the measurement results can provide important reference data for the structural design , mechanical performance analysis and aerodynamic research of aerospace equipment.
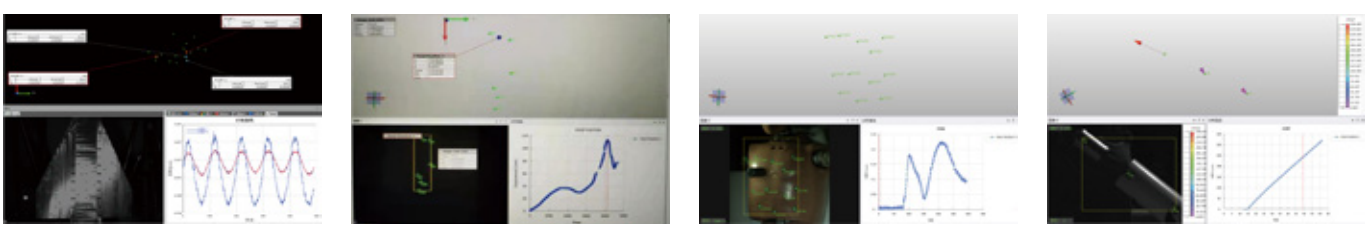
Aircraft model vibration test

Missile launch moment barrel vibration displacement test

Dummy bullet impact test

Projectile launch speed test

Aerial motion trajectory tracking

When aerospace equipment flies in the air, the attitude and motion trajectory of key parts (such as bomb stores, wing, etc.) may change. its 3D motion trajectory attitude measurement information, and present the test results in the form of visualisation, to solve the problem of 3D dynamic deformation measurement of aerospace equipment in air flight.
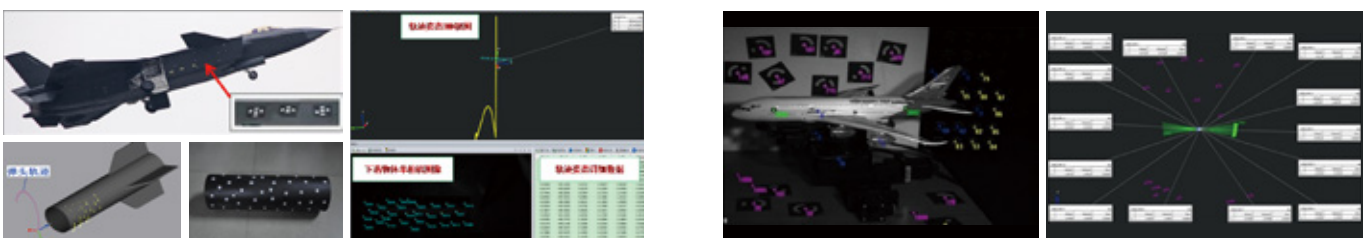
Projectile trajectory test
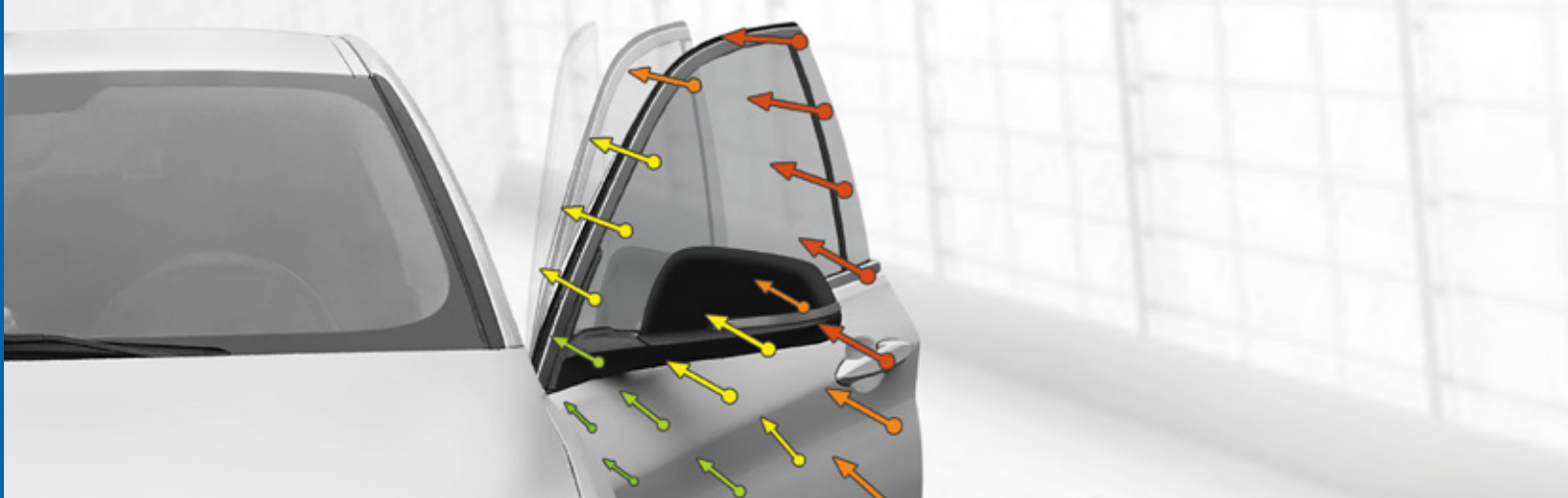
Aircraft wind tunnel test attitude test
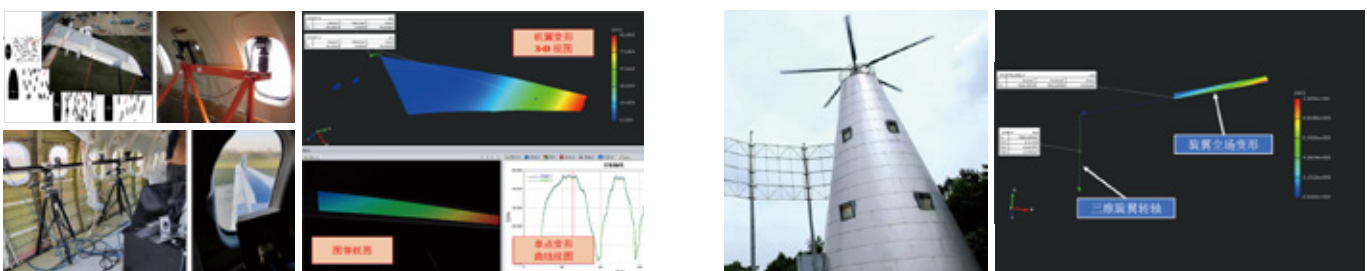
Aircraft wing deformation test

Helicopter rotor deformation and motion parameter measurement test

Automobile industry

Relying on advanced 3D measurement technology, help automobile manufacturing industry fly.


In recent years, the number of cars in China has been rising, and the automotive market, which offers a wide range of business opportunities, has become a major arena for many manufacturers to compete. Due to the need to shorten the production cycle and control costs, automobile manufacturers must be more efficient in project development and production process control.

The application of XTDIC system runs through every core process of automobile manufacturing, from material testing of new models, component strength testing, vehicle wind tunnel testing, to automobile safety testing, etc. With its professional technology and rich industry applications, XTOP3D helps the automobile manufacturing industry fly.

Material connection technology

XTDIC system can be used to test and analyze the performance of material connection technology.

- Welding experiment
- Tensile, compression and bending test of welding
- Tensile test of hinge and riveting
- Verify CAE parameters and improve CAE model
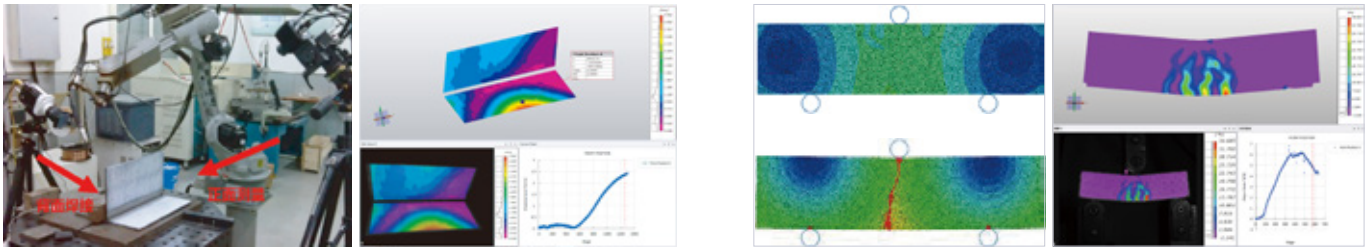
High temperature welding deformation test

Finite element analysis verification

Component strength test

The XTDIC system can be easily integrated with standard or non-standard test benches to measure the dynamic deformation of components in service, evaluate factors such as twisting, bending, displacement, velocity and acceleration, analyze safety risks, part life, creep, aging and appearance changes during use, and provide designers with test data verification to optimize product design.

- Crash and fatigue tests
- Wind tunnel tests
- Tire deformation tests
- Seismic test benches
- Door opening/closing tests
- Cooling fan deformation test
- Car front cover crash tests
- Load bearing structure and axle force
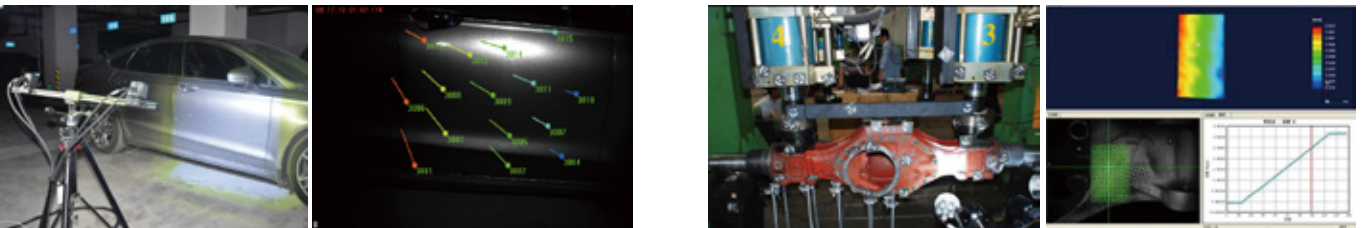
Door opening/closing test


Axle loading test

New energy vehicles

New energy vehicles are changing dramatically in power sources, and the quality inspection of drive motors, electronic controls, batteries and transmission mechanisms has prompted the industry to introduce innovative mechanical performance testing programs. XTDIC system plays an important role in the research and development and quality control of new energy three electrics, providing data support for the design and improvement of electric performance.
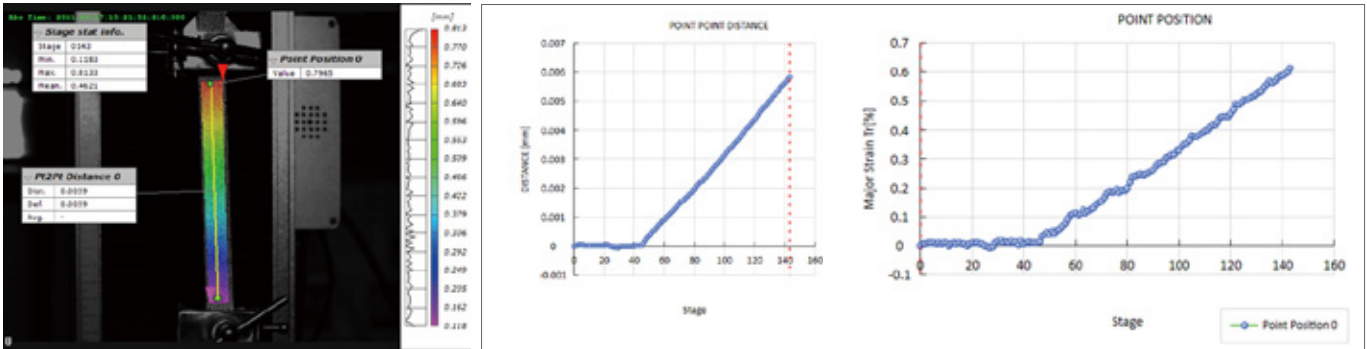
Copper foil tensile test
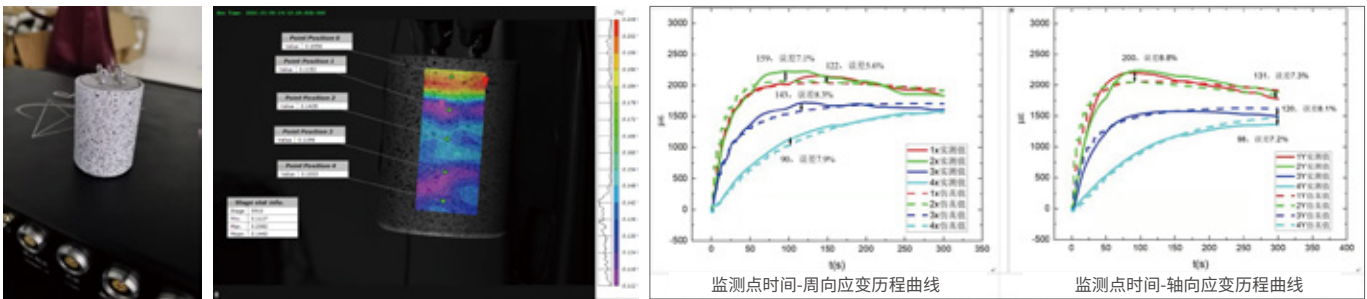
Battery load strain test
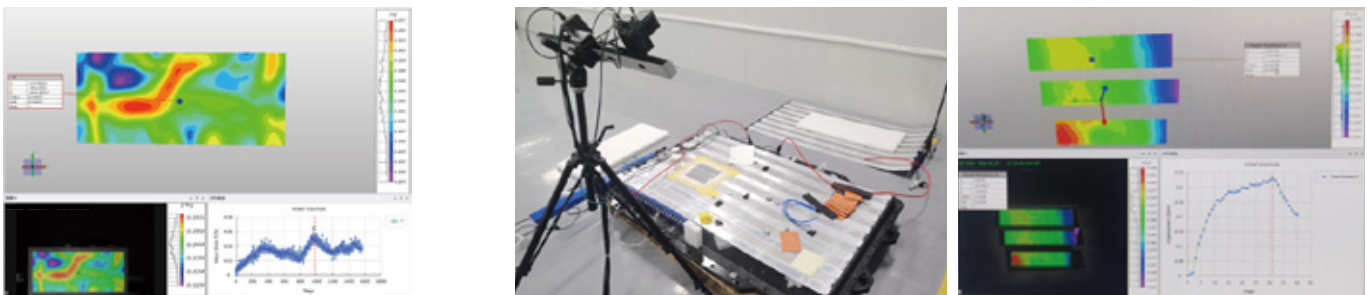
Battery charge and discharge strain test

Battery pack stress and strain test under impact and vibration

Civil engineering

## Build the foundation of national large-scale infrastructure projects

Engineering quality and material mechanical testing in complex geographical and geological environments have always been a difficult problem in the industry. The XTDIC system can acquire 3D full-field deformation data of the measured object, realize the dynamic and static deformation measurement during the test, so as to protect the safety and health of materials and engineering structures.
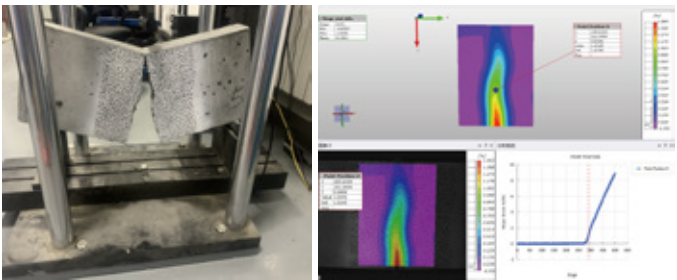
Material mechanical properties test

The damage mechanism and damage pattern analysis of civil engineering materials have always been the common concern of the mechanics, materials science and engineering technology communities. XTDIC system is suitable for mechanical experiments such as extension, compression, three-point/four-point bending, Hopkinson test, explosion impact test, rock splitting,etc. It is a non-contact full-field deformation measurement solution and has been widely recognized and praised in the industry.

• Concrete compression   • Explosion impact test   • Three-point bending/four-point bending

• Hopkinson test   • Rock splitting test
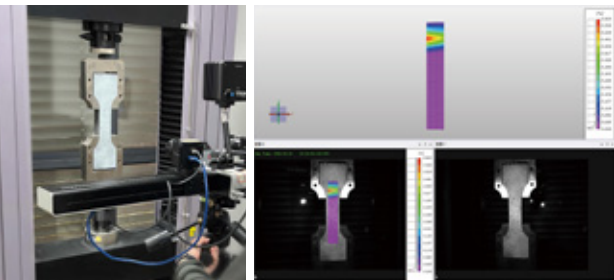
UHPC Ultra High Performance Concrete Tensile Test   Three-point bending Test

Structural testing

With the increasing height of modern buildings, it is an important work to study the damage mechanism and seismic performance of the structural system under vibration or impact, etc. XTDIC system is different from the traditional strain gauges, displacement sensors and other testing methods, which, with the help of machine vision and image technology, allows the experimenter to observe the structural deformation of the hybrid structure under the action of stress conveniently,, injecting new technology into civil engineering structural testing.
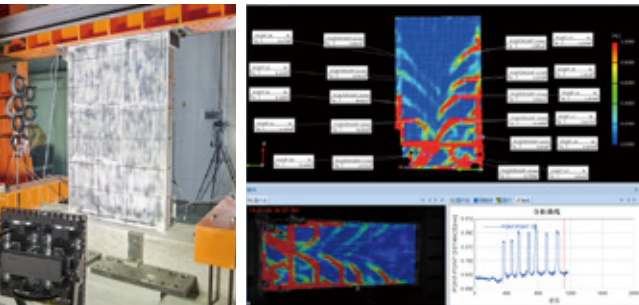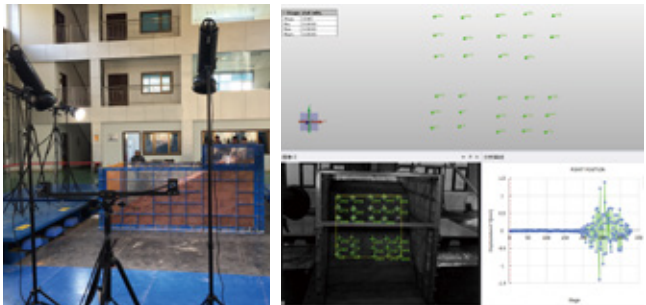

Wall seismic test   Slope test

## Static load deformation test

Using static load deformation testing under experimental conditions, the damage and destruction of coal mining, overburden fissure development and other processes can be analysed. By using XTDIC system to conduct model mining, settlement deformation, structural displacement and collapse test to provide data basis for safe mining and collapse control solutions.
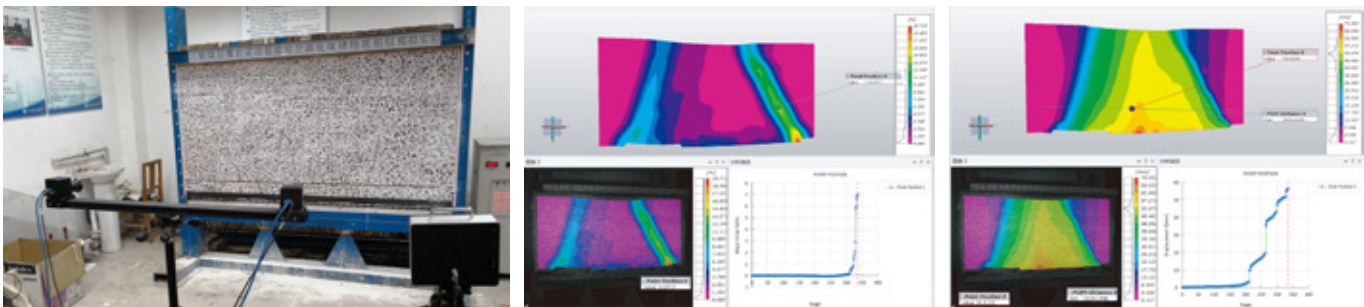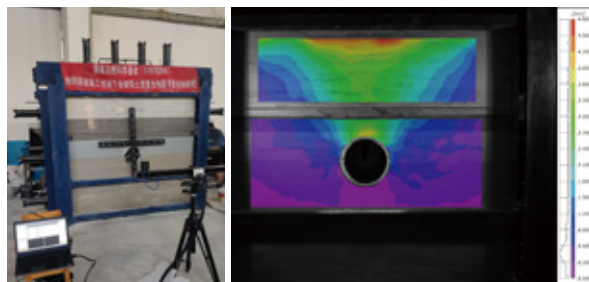

Physical similarity simulation test on temporal and spatial evolution law of mining cracks overlying three soft coal seams
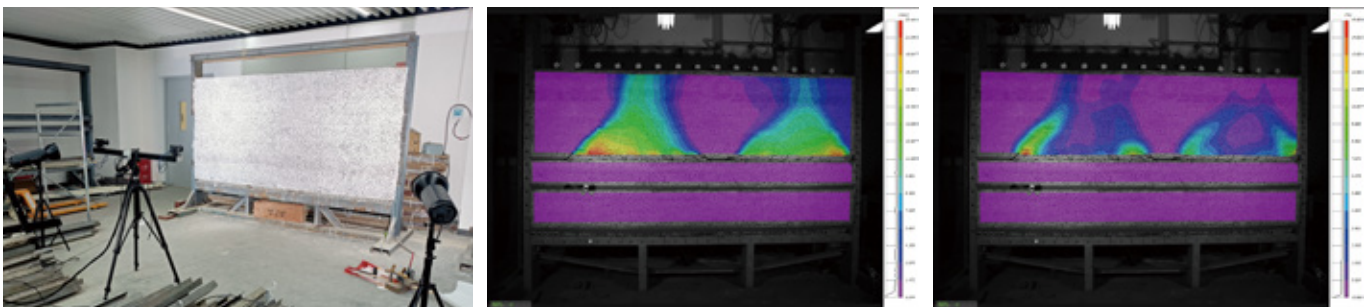
Mechanism and monitoring test of ecological environment damage caused by coal mining
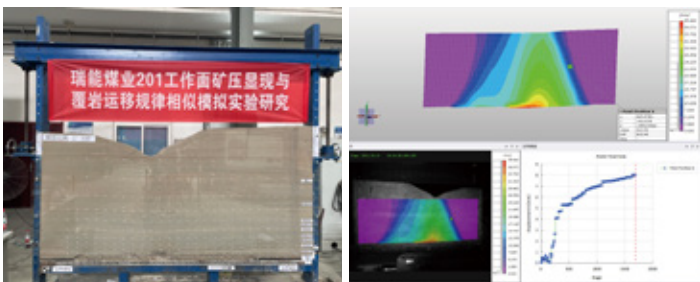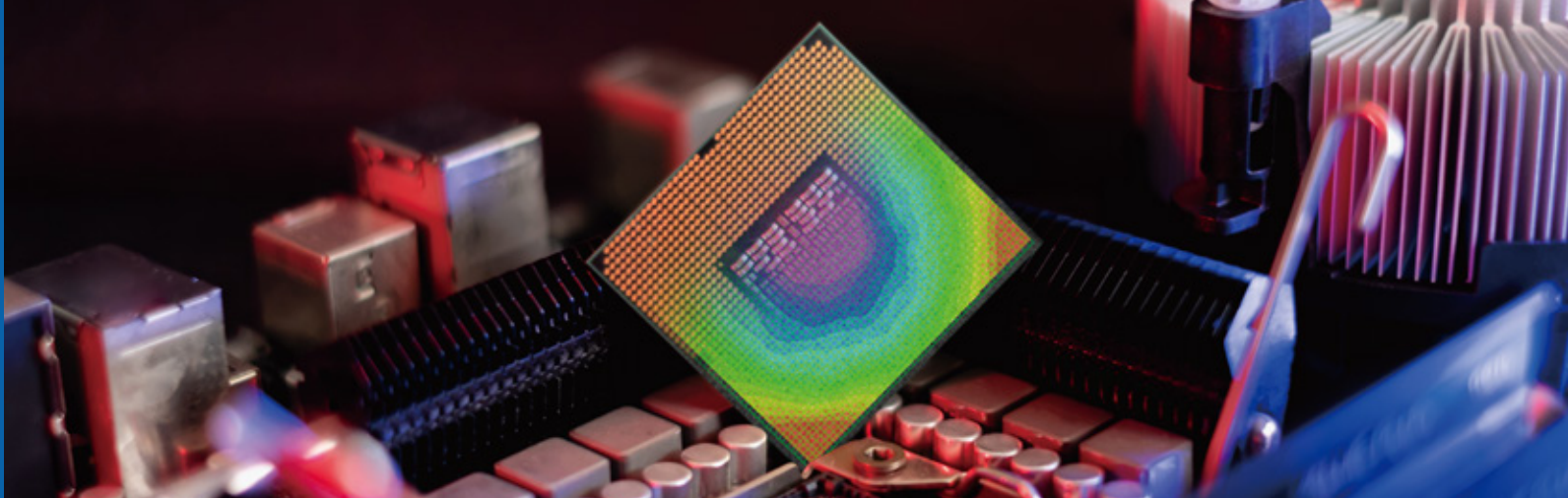

Similarity simulation experiment study on migration law of overburden strata   Tunnel collapse simulation test

Electronics and semiconductors

## Improve the efficiency of rapid product iteration

The electronics and semiconductor manufacturing industry has complex processes and extremely high precision. Any slight deviation in process parameters may lead to a decrease in yield rate, thus affecting product quality.

XTDIC system has the advantages of non-contact measurement, full-field measurement, result visualisation, etc. It can be used in different working conditions, sizes and materials, and is especially suitable for the testing of electronic and semiconductor components, completing mesoscopic scale material testing, chip thermal warpage, structural deformation testing and analysis.

Micro-material mechanical properties testing

Under the background of miniaturization and integration of electronic components, the mechanical and thermal properties of micro-sized materials and devices have become the focus of attention. XTDIC system can be equipped equipped with stereo microscope, high and low temperature environment chambers, micro-test machine, etc., to achieve mechanical property tests such as stretching, compression, and bending of micro electronic materials, and performance analysis such as fatigue fracture, high temperature deformation, and thermal expansion of electronic devices.
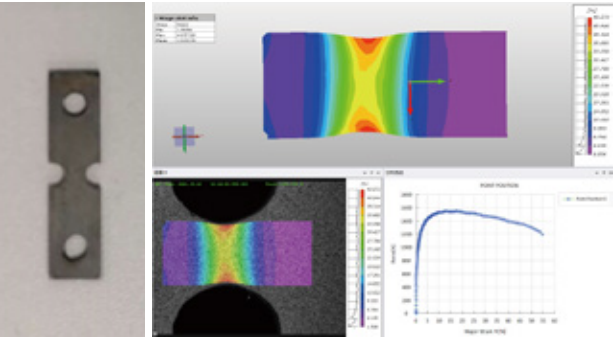
Dumbbell-shaped metal material tensile test
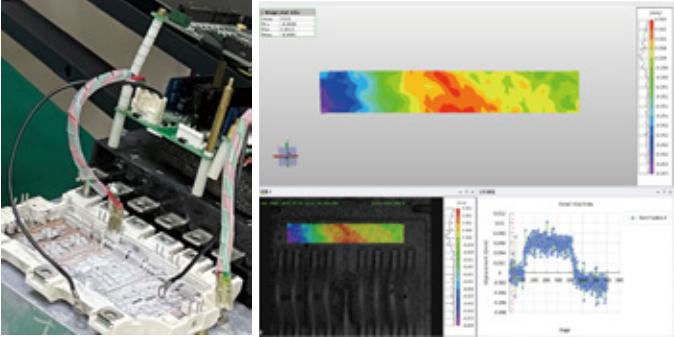
Component thermal deformation test
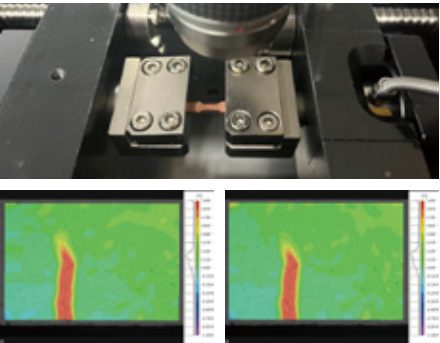
Material microstructure crack propagation test
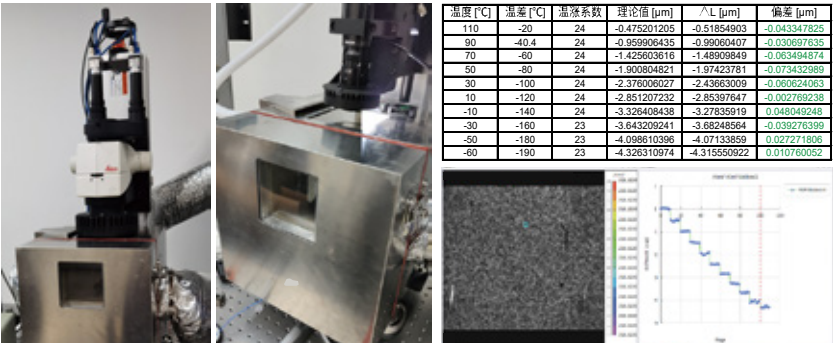
Material high and low temperature thermal expansion test

Structural testing

Electronic components and semiconductors undergo changes in structure, morphology and local stresses when subjected to force, heat and motion, etc. The XTDIC system can measure the dynamic strain deformation of components in service, evaluate the impact of components under loads such as twisting, bending, displacement, acceleration, analyze safety risks and appearance changes during use, etc., provide designers with test data verification and optimize product design.
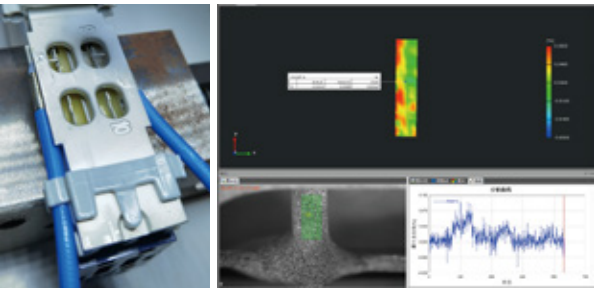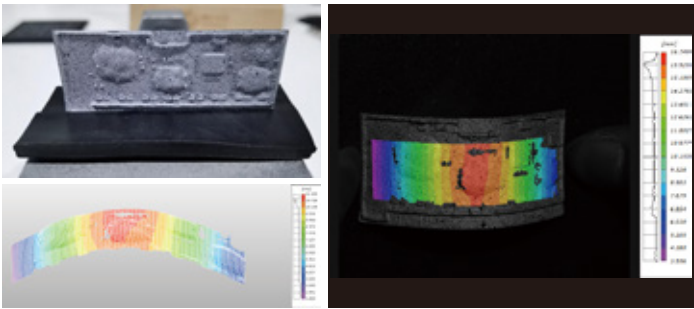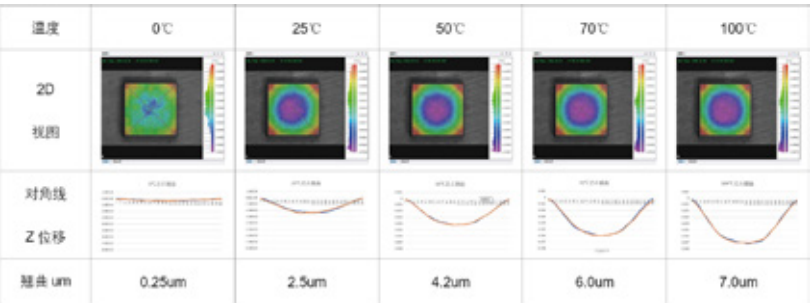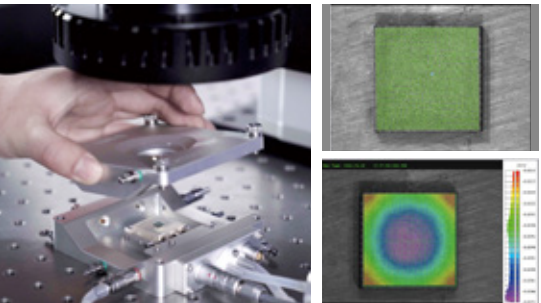
Solder joint inspection test
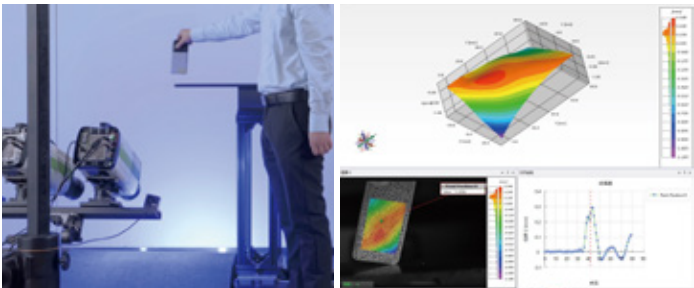
Mobile phone drop test
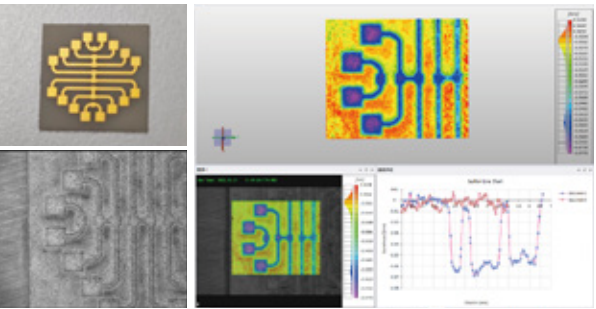
Ceramic in-plane strain test for copper foil on printed circuit boards

Flexible screen bending test

Chip thermal warpage test

Biomedicine

Protect health and inject new impetus into medical technology

With the deepening of global aging and the general improvement of people's health awareness, the medical industry has continued to develop rapidly in recent years.

XTDIC system is a non-contact optical testing technology that is widely used in fields such as medical technology and biomechanics. It is an ideal one-stop measurement solution for dynamic analysis of biomaterials (such as strain, load and fatigue testing).

Safety protection

The XTDIC system can be used to test the mechanical properties of special protective materials, such as bullet-proof clothing, stab-proof clothing, helmets, etc., and analyze the instantaneous deformation of special protective materials under high-speed impact and puncture.
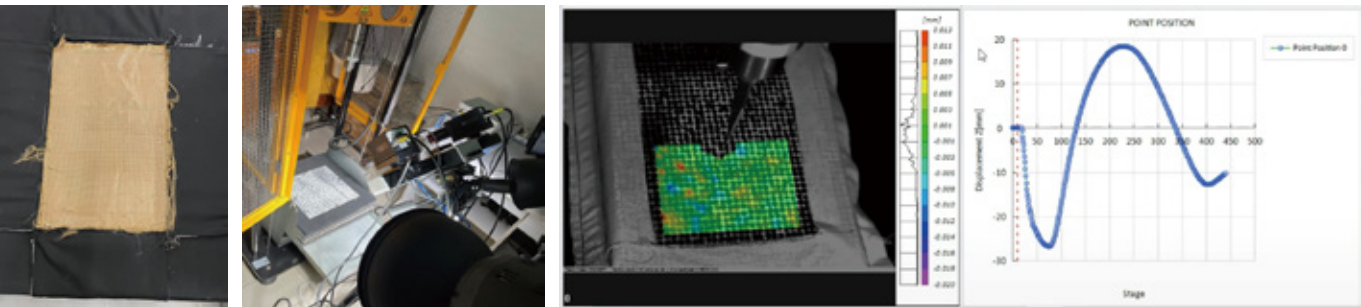

Puncture transient deformation test of Puncture-resistant clothing
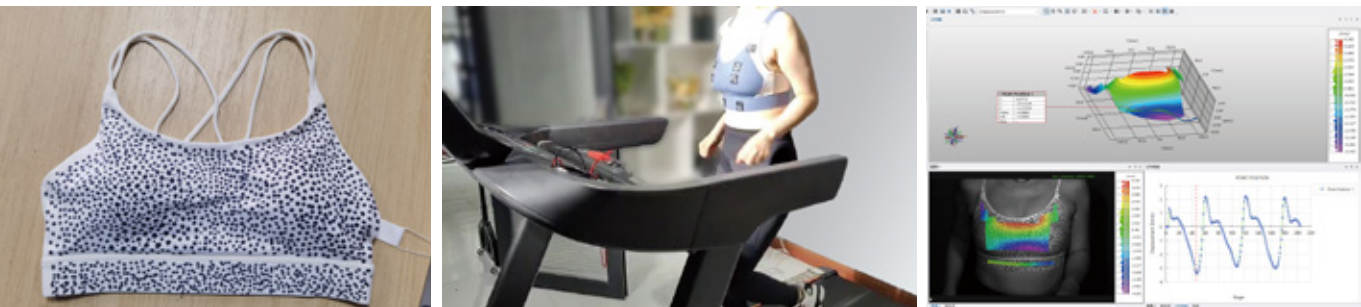
Shockproof test of sports bra material

Biomechanics

In the field of biomechanics, traditional measurement techniques face huge challenges. XTDIC system can be used to measure the huge changes in real biomechanical systems such as bones, tendons, ligaments and even tissues such as blood vessels. Compared with other traditional testing methods, XTDIC measurement method involves a larger dynamic range, thus better realizing full-field dynamic measurement.
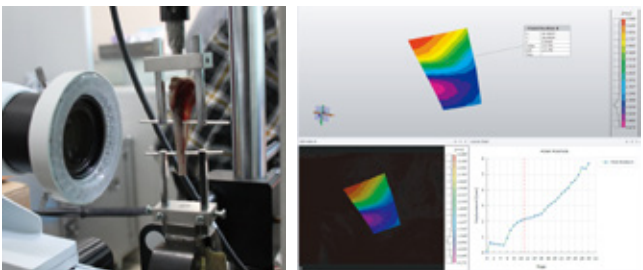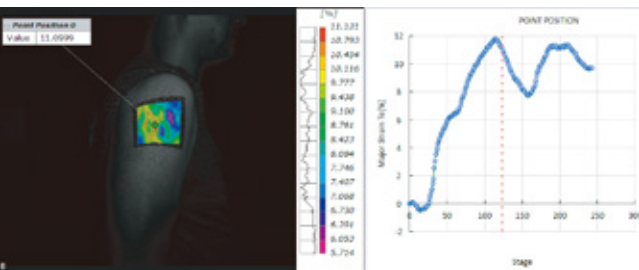

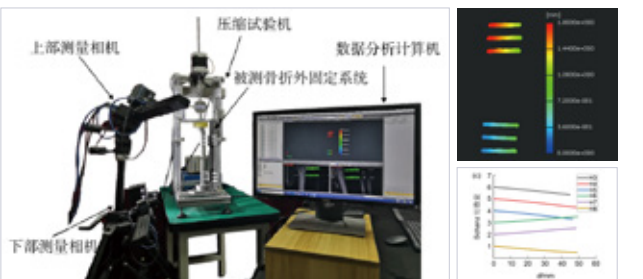
Chicken tibia stress deformation test
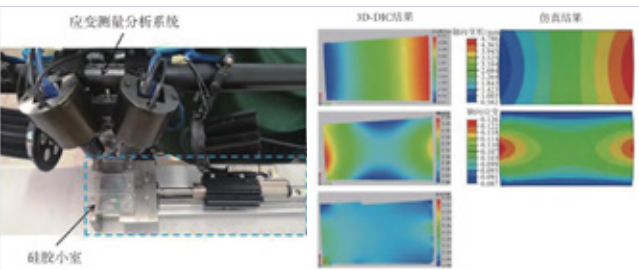
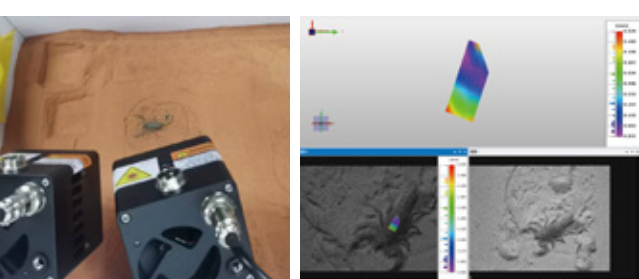Cell culture room biomechanical test
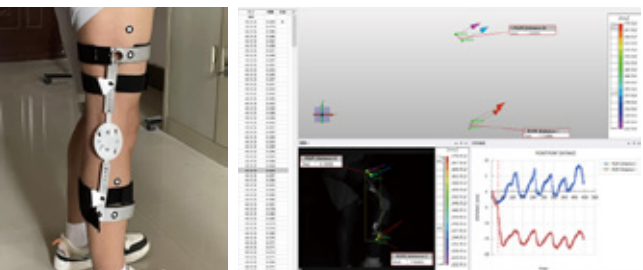
Artificial hip joint analysis test

Human shoulder muscle contraction test

3D printed tibia fracture external fixation biomechanical test

Scorpion surface strain test after thermal stimulation