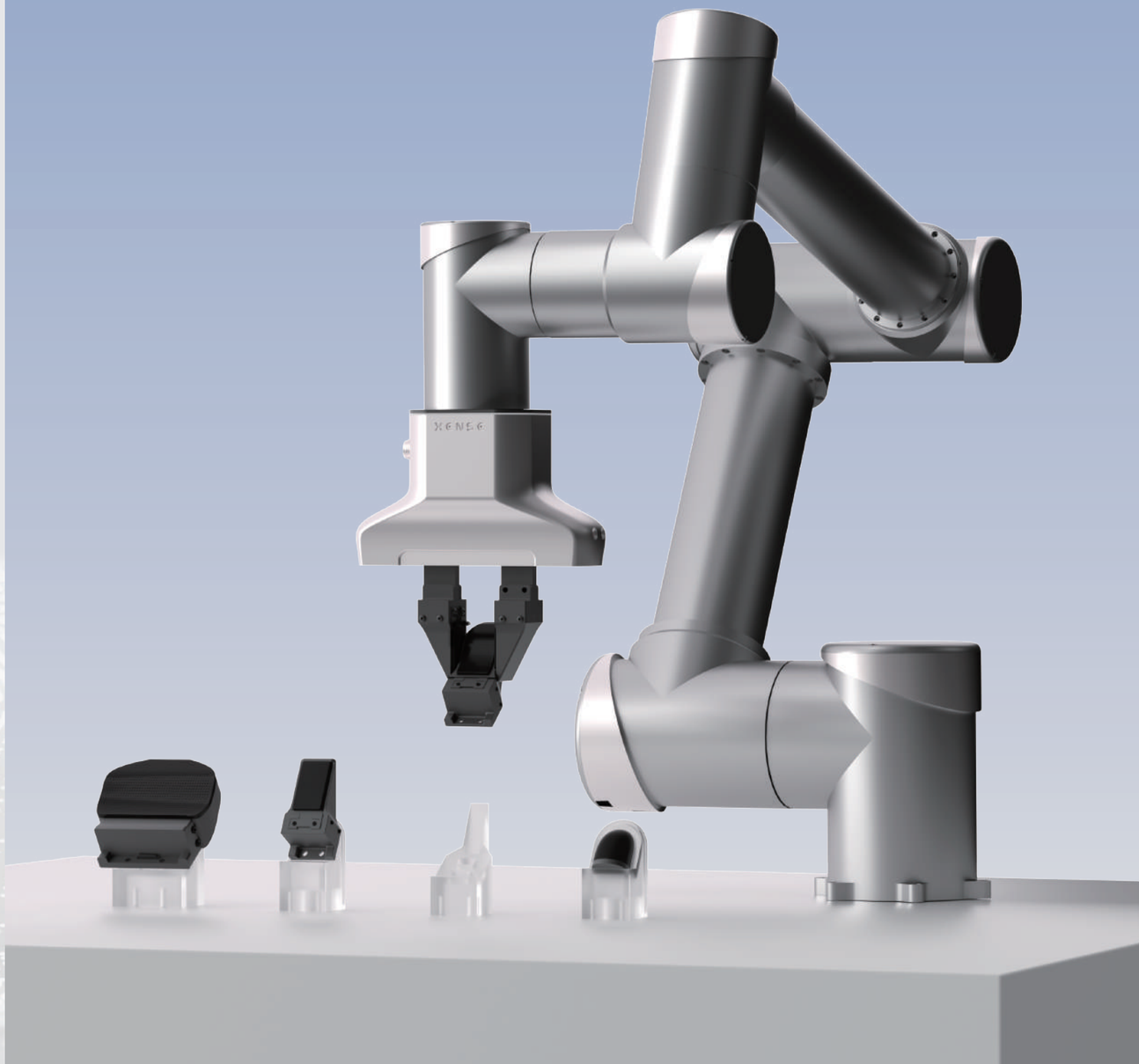
XENSE 千觉

EXPLORING THE LIMITS OF PERCEPTION
CONNECTING TO THE FUTURE

HIGH-PRECISION MULTIMODAL TACTILE SENSING TECHNOLOGY



Introduction

XENSE ROBOTICS, was founded in May 2024 with a clear mission: to redefine robotic dexterity through multimodal tactile perception. By giving intelligent agents the sense of touch, we enable robots to truly understand and interact with the physical world—paving the way from fine-grained manipulation to general physical intelligence.

XENSE delivers a complete suite of tactile solutions—from tactile sensors, tactile data collection, tactile end-effectors, and simulators to embodied control frameworks—designed for real-world applications. Our focus is multimodal tactile perception and intelligent technologies for precision manipulation. Our proprietary high-precision multimodal tactile sensors break through the limitations of conventional tactile sensors, which can only capture pressure distribution with limited resolution. Combined with our intelligent perception and control algorithms, they enable a full-stack solution—from multidimensional sensing and AI decision-making to seamless robotic solution in real-world scenarios.

Leadership& Team

Our founder, Prof. Daolin Ma, is a leading scientist in tactile perception and Associate Professor at Shanghai Jiao Tong University. He won the Best Paper Award at ICRA 2021, the leading international conference in robotics, and pioneered a new paradigm of robotic manipulation based on spatial perception through touch. The core team brings together top talents from world-class institutions such as MIT, Peking University, Shanghai Jiao Tong University, Fudan University, University College London, and the University of Sydney.

Mission

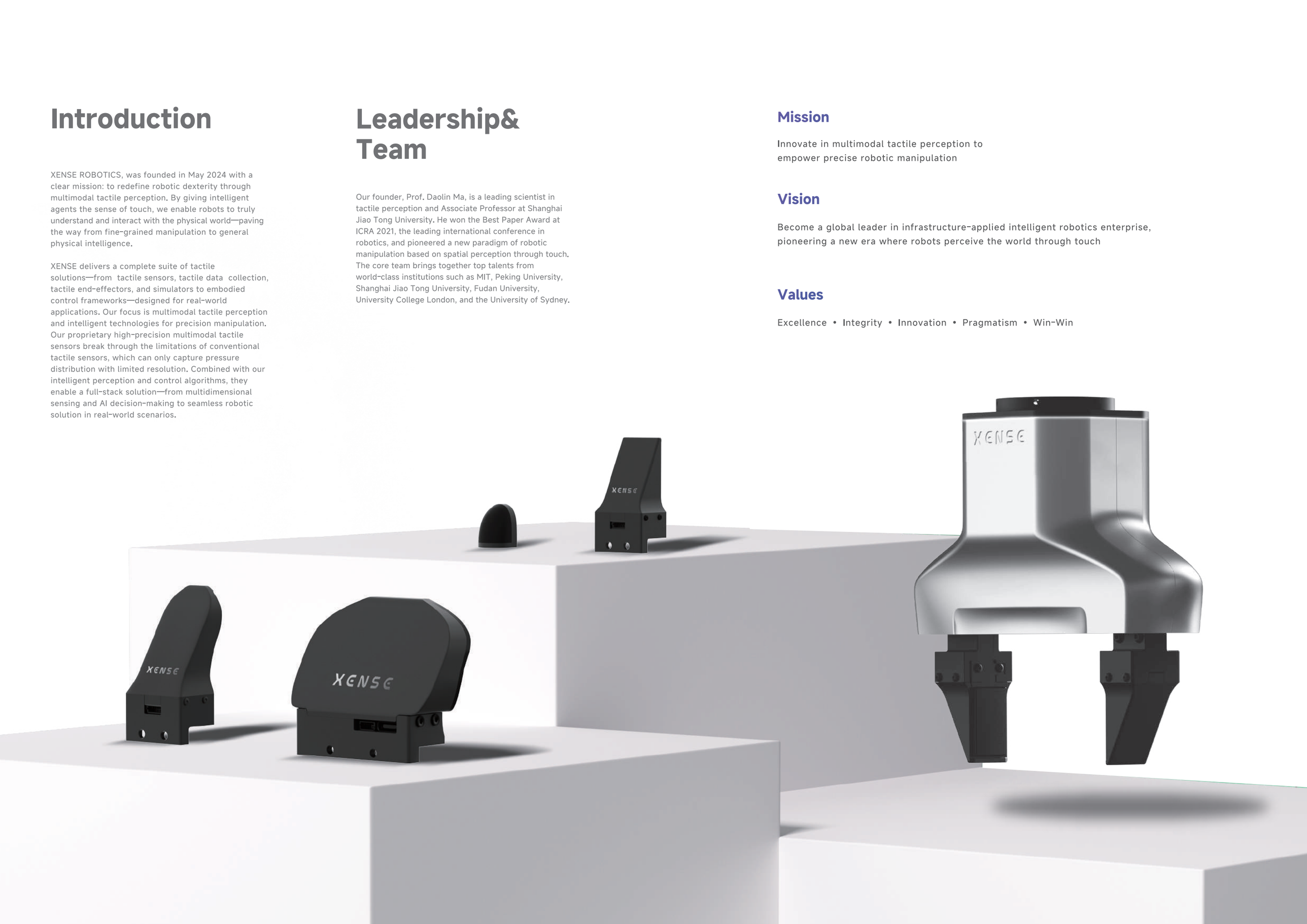
Innovate in multimodal tactile perception to empower precise robotic manipulation

Vision

Become a global leader in infrastructure-applied intelligent robotics enterprise, pioneering a new era where robots perceive the world through touch

Values

Excellence • Integrity • Innovation • Pragmatism • Win-Win



Technological Advantages

Core Technology

Built on multimodal tactile perception and intelligent control, XENSE overcomes the limits of conventional tactile sensors that have only pressure-sensing capability and lack sufficient resolution. By leveraging high-precision multimodal sensors, advanced perception & control algorithms, simulation-based training, and embodied multimodal fusion models, Xense Robotics form a comprehensive perception ecosystem.

Our proprietary multimodal tactile sensors deliver high-resolution, multidimensional data—including force, kinesthesia, slip, 3D surface mapping, and texture recognition—simultaneously. For the first time in the world, we enable robots to achieve high-precision motion tracking through only touch feeling. We also pioneered the theoretical framework of Extrinsic Contact Sensing, which allows robots to perceive both extrinsic contact “force” and “motion” at the same time, opening up a new pathway for fine-grained perception and manipulation in intelligent agents.



Precision Optical Design

Employs a compact, optimized optical path to significantly reduce sensor size, enabling seamless integration into dexterous hands and other complex mechanical structures with high adaptability.

Multimodal Tactile Perception Algorithms

Leverages deep learning and multi-sensor fusion to calibrate depth information with high precision—without relying on marker points. Supports multimodal capabilities including 3D shape perception,
6-axis distributed force detection, and slip sensing, while optimizing algorithm architecture to reduce computational load and deliver efficient tactile feedback.

Automated Calibration Technology

Our proprietary high-precision calibration algorithm automatically collects sensor images, encodes them into high-dimensional features via an embedded encoder and computes calibration parameters to ensure consistent out-of-the-box sensor performance, with real-time error compensation to ensure long-term operational stability.

Tactile Simulation Technology

Leverages advanced optical and mechanical simulation models to generate high-fidelity tactile data, supporting AI training for robots and enhancing generalization capability of tactile models.

VTLA Multimodal Control Technology

Integrates vision and tactile information through a physics-informed Transformer framework, decoupling high-level scene reasoning from fine-grained interaction control. By leveraging imitation learning and reinforcement learning, it establishes a perception-to-control closed loop, enabling robots to generalize precise operational skills to novel environments.

Technology Framework of Tactile Sensing, Perception, Simulation, and Control

Accelerating the Tactile Ecosystem,
Powering Industry Applications

Hardware Layer (Core Products)

Multimodal Tactile Sensor
Tactile-enabled End-Effector
Contact-based 3D Surface Measurement Instrument

Perception Layer

Multi-Channel Tactile Data Processing Unit
Support Edge-side Data Processing
Multimodal Tactile Perception Algorithms
Lower Implementation Barriers to Booster

Ecosystem Layer

XenseSimTactile Simulation Platform
Tactile Parallel Computing Technology
Tactile Data Acquisition Toolchain

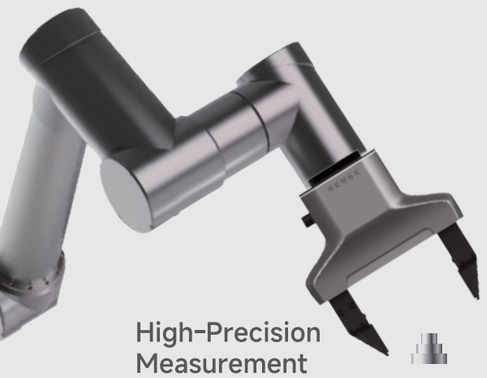
Control Layer

Multimodal Tactile Representation Learning
Tactile Cerebellum Algorithm
Embodied VTLA Model

Self-Calibration Technology

Automatic Calibration & Easy Replacement





High-Precision Measurement

μm-Level
spatial resolution

mN -level
Resultant Force Accuracy

Product Highlights

The sensor features a compact design with micron-level spatial resolution and 350 markers/cm², supporting multimodal perception including 3D surface mapping, texture recognition, 6-axis resultant force, 3D distributed force, slip detection, and motion tracking. The XENSE series delivers outstanding performance in resolution, anti-interference capability, multimodal fusion, and dynamic response, making it ideal for embodied robotics, automated fine manipulation, tactile inspection, flexible e-commerce logistics, and human-robot interaction.





Tested over **5 Million** Cycles

With the Flexible Surface Remaining Fully Intact.

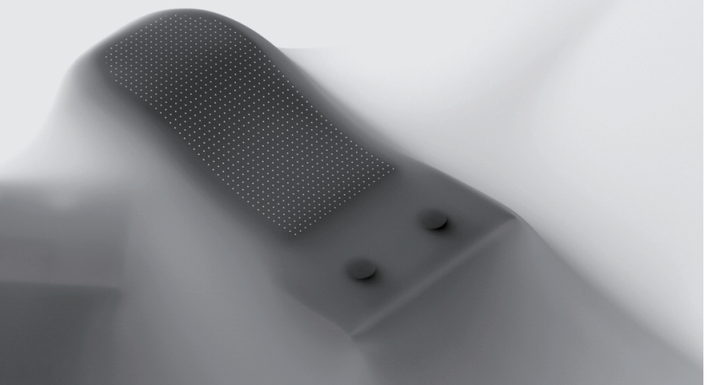
Indirect Contact Perception

Enables High-Precision Motion Tracking via Tactile Sensing



Multimodal Perception

4 Fundamental Tactile Modalities +
X Composite Tactile Sensing Applications



4cm³

Compact Design

Ultra-Compact 4 cm³ Sensor





Optimized Automated Production Cycle

Accurate pose estimation,
80% efficiency improvement,
latency as low as 3 ms,
supports embedded real-time operation,
reduces repetitive actions,
and enhances production cycle.

Maximum
Sampling Frequency **150HZ**



Backend Services

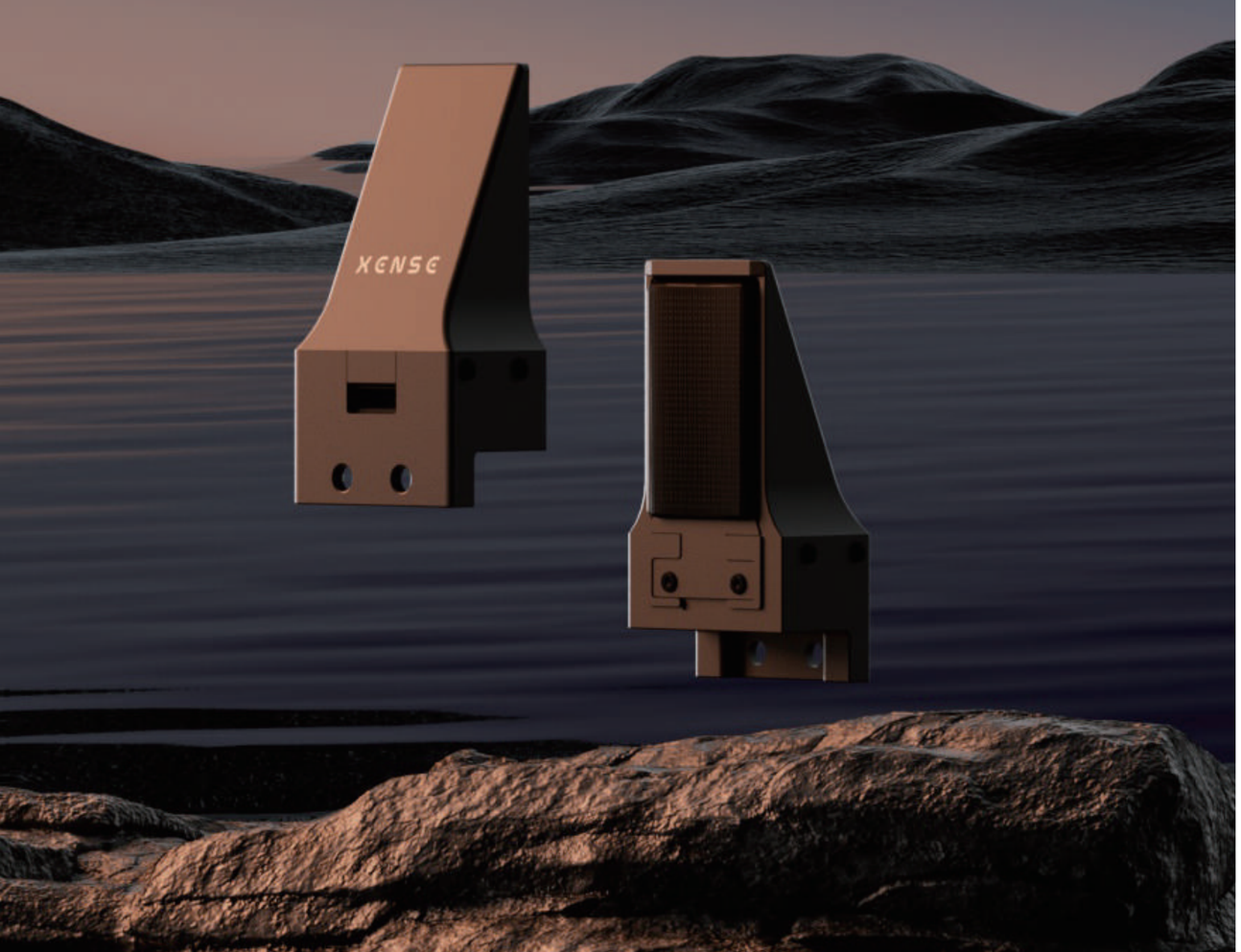
Our visualization software and tactile simulation empower customers to fully leverage their tactile data. The high-fidelity platform cuts data costs by 95%, facilitates the creation of the largest tactile dataset, pioneers a pre-training–transfer learning framework, and increases task success rates by 35%.

Product Introduction

Xense Robotics' product portfolio centers on multimodal tactile perception, delivering the world's leading series of multimodal visuo-tactile sensors, including models Photon,Quak N1,Quak W1,and Elf. These sensors feature compact dimensions with Micrometer-level spatial resolution and 350 markers/cm² density, supporting multimodal perception of 3D Surface Morphology Perception, six-axis resultant force, 3D distributed force, slip detection, and motion tracking.

Compared to capacitive, resistive, and Hall-effect tactile sensors, Xense tactile sensor series demonstrates significant superiority in resolution, anti-interference capability, multimodal fusion, and dynamic response, making them suitable for applications in embodied robotics, automated fine-tuned flexible operations, tactile inspection, flexible e-commerce logistics, and interactive perception.

In these applications, our tactile sensors integrate with intelligent perception algorithms and control algorithms to form robotic systems that deliver a revolutionary new-generation automated solutions, empowering key industries including next-generation productivity sector, advanced manufacturing, smart healthcare, and modern logistics, thereby enhancing production efficiency and operational consistency while strengthening enterprise competitiveness.





Photon
(Planar Sensor)



Quark N1
(Curved Sensor - Narrow)

Flexible Layer Thickness	2-5mm	2-5mm
Sensing Area	17.5 (H)×29.5 (V)mm	18 (H)×33 (V)mm
Dimensions (L×W×H)	52.8×27×22mm	54.3×26.7×22mm
Marker Density	120 /cm²	100 /cm²
Supply Voltage	5V	5V
Sensing Modality	3D Surface Measurement, Texture Recognition, 6-DoF Force, 3D Distributed Force, Slip Detection, Motion Tracking	3D Surface Measurement, Texture Recognition, 6-DoF Force, 3D Distributed Force, Slip Detection, Motion Tracking
Spatial Resolution	0.03mm	0.03mm
Sampling Frequency	30-150Hz*	30-150Hz*
Communication Protocol	UVC	UVC
Power Consumption	0.6W	0.6W
Deformation Field Accuracy	0.06mm	0.06mm
Resultant Force Accuracy	0.02N*	0.02N*



Quak W1
(Curved Sensor - Wide)



Elf
(Microsensors - Fingertips)

Flexible Layer Thickness	2-5mm	2-5mm
Sensing Area	25 (H)×35 (V)mm	15 (H)×18 (V)mm
Dimensions (L×W×H)	61.5×60×27mm	22.2×15.4×14.2mm
Marker Density	100 /cm²	125 /cm²
Supply Voltage	5V	5V
Sensing Modality	3D Surface Measurement, Texture Recognition, 6-DoF Force, 3D Distributed Force, Slip Detection, Motion Tracking	3D Surface Measurement, Texture Recognition, 6-DoF Force, 3D Distributed Force, Slip Detection, Motion Tracking
Spatial Resolution	0.03mm	0.04mm
Sampling Frequency	30-150Hz*	30-150Hz*
Communication Protocol	UVC	UVC
Power Consumption	1W	0.3W
Deformation Field Accuracy	0.06mm	0.08mm
Resultant Force Accuracy	0.02N*	0.03N*

* Products undergo continuous optimization and upgrades.
Please refer to our official website for the latest specifications.

Technical Advantages

Feature	Xense Vision Tactile Sensor	Capacitive Tactile Sensor	Resistive Tactile Sensor	Hall-effect Tactile Sensor
Principle	Optical imaging + elastomer deformation	Detects contact position/ force via capacitance changes	Detects pressure distribution via resistance changes	Measures contact position/force via magnetic field changes
Resolution	Extremely high	Medium	Medium	Medium-high
Environmental Interference Resistance	Strong (immune to electromagnetic interference)	Weak (susceptible to temperature, humidity, EMI)	Moderate (affected by temperature)	Moderate (requires external magnetic shielding)
Measurement Dimensions	3D surface measurement, texture recognition, 6-axis force, 3D distributed force, slip detection, motion tracking	2D position + single-point force	Single-point / simple area force	Single-point position + 6-axis force
Dynamic Response Speed	30–240 Hz (varies by model)	100-1000Hz	50-200Hz	100-500Hz
Long-term Stability	High (stable optical signals, non-contact sensing reduces drift)	Medium-low (baseline drift due to temperature and humidity changes)	Low (resistive materials fatigue, nonlinear decay)	Medium (magnetic interference may cause zero-point drift)
Core Advantages	High resolution, precision, interference resistance, dynamic response, real-time performance; excellent multimodal integration and long-term stability	\	\	\

Product Introduction

XENSE Robotics Aurora Lite Intelligent Tactile Gripper Series integrate proprietary high-precision visuo-tactile sensors and flexible drive-control modules, featuring an embedded edge computing unit for local tactile data acquisition, processing, and transmission. Our proprietary high-speed communication components ensure low-latency, lightweight operation and easy usability, while a flexible network topology significantly reduces maintenance costs.



Multimodal Tactile Perception

Real-time acquisition of contact force, surface deformation, and slip trends during contact, accurately reproducing the interaction between object and gripper. Designed for industrial and research applications that demand precise manipulation and stable gripping, enabling robots with near-human tactile perception capabilities.

Highly Integrated Design

The sensors, computing platform, and control system are compactly integrated within a single gripper, minimizing external dependencies. Simplified wiring and small form factor enhance reliability and ease of installation.

Built-in High-Performance Computing Platform

Equipped with a 6 TOPS high-performance computing unit capable of locally running complex algorithms. Supports adaptive grasping, intelligent control, and multi-task operations without reliance on a host computer, providing robust computational support for demanding applications.

Plug-and-Play for Multiple Scenarios

Lightweight design with standardized interfaces allows instant connection and rapid deployment. Easy to use in manufacturing lines, robotic platforms, or research labs, providing flexible operation across diverse environments.

Integrated Sensing and Control

Supports multiple sensing and control modes, including position, velocity, force, contact pressure, and slip trend detection. Deep integration of sensing and control ensures highly precise, safe, and efficient gripping operations across a variety of tasks.

Cross-Platform Ecosystem Compatibility

Supports a wide range of robotic platforms and operating systems, seamlessly integrating with mainstream manipulators and intelligent control systems to create an open tactile ecosystem.

Gripping Force (One Side)	40 N max
Maximum Recommended Load	2 kg
Total Stroke	85 mm
Full Stroke Open/Close Time	0.3 s max
Maximum Speed	140 mm/s
Position Repeatability	±0.01 mm
Backlash	<0.1 mm per side
Distributed Force Sensing Resolution	0.0005 N
Resultant Force Sensing Resolution	0.02 N
Operating Noise	<50 dB
Dimensions (L × W × H)	150 mm × 60 mm × 152 mm
Weight	615 g
Operating Voltage	24 V
Rated Current	2 A
Operating Temperature	0–45 °C
Operating Humidity	35–80 % RH (non-condensing)
Ingress Protection (IP) Rating	IP54
NPU Computing Power	6 TOPS INT8
Supported Data Types	INT4 / INT8 / INT16 / FP16, etc.

Technical Advantages
Gripper Comparison

Comparison Dimension	Xense Tactile Gripper	Pneumatic Gripper	Electric Gripper	Electric Gripper + External Tactile Sensor
Drive Method	Motor-driven	Compressed air-driven	Motor-driven	Motor-driven
Sensing Capability	Built-in high-resolution tactile sensing; real-time detection of contact force distribution, slip, deformation; supports tactile-driven control	No sensing capability	Estimates gripping force via current loop; cannot distinguish contact modes	Depends on the performance of the external sensor
Control & Algorithms	Embedded computing power; supports direct deployment of adaptive grasping, slip detection, flexible body control, etc., without a host computer	Simple on/off control; no closed-loop	Position/current loop control,limiting the implementation of complex algorithms	Algorithms rely on a host computer; additional integration required
Integration	Sensor + computing + gripper fully integrated; plug-and-play	Requires external air supply and valve control system	Plug-and-play	Gripper, sensor, and data acquisition modual included, resulting in a bulky system
Operational Precision	Enables stable grasping of slippery or delicate objects without causing damage	Suitable for rough handling	Suitable for rigid workpieces but may damage flexible ones	Precision depends on external sensorand algorithm latency
Cost Level	Medium; feature-complete and reduces system integration cost	Low; suitable for high-volume loading and unloading	Medium; suitable for general automation	High; hardware + integration + algorithm cost
Application Scenarios	Precision assembly, flexible object handling, suitable for both industrial and research applications	High-volume rigid material handling	Standard workpiece assembly	Research and development experiments, specific applications
Key Advantages	Fully integrated manipulation, sensing, and computing; supports tactile-driven closed-loop control without the need for an external host	Simple and inexpensive, but with limited functionality	Mid-rang cost， but lacks true force control and real tactile feedback	Has sensing capability, but the system is bulky and high-latency

Application Scenarios



Embodied Robot

Dexterous Hands.

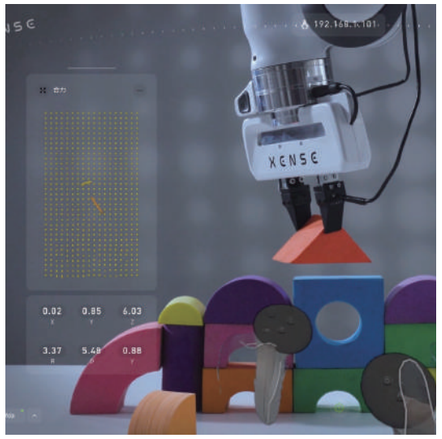
Integrate multimodal tactile perception to achieve high-precision grasping and adaptive manipulation, enabling detailed perception of object surface pressure, morphology, and texture.

Humanoid Robots.

Combine tactile perception with vision to construct spatial cognition models, enhancing natural interaction and emotional experience.

Service Robots.

Monitor contact forces and motion trajectories in real-time, optimizing task paths to improve efficiency and reliability in complex environments.



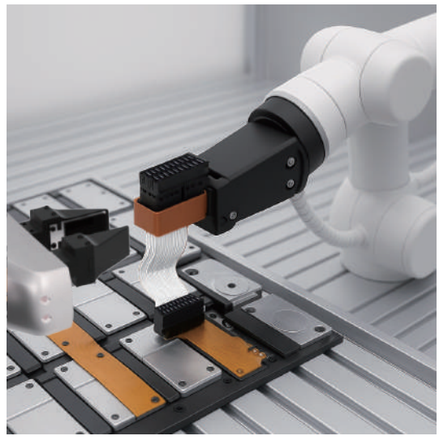
Data Acquisition (DAQ)

Real-World Data Acquisition.

Provides a complete set of acquisition hardware and supporting SDKs, enabling the construction of a full data acquisition pipeline to.efficiently capture high-quality tactile data.

Simulated Data Acquisition.

Equipped with a high-precision simulation platform, it generates large-scale tactile datasets at low cost， complements real-time interactions on edge device, and enhances the accuracy of tactile simulations and the quality of trained models.



Industrial Manufacturing

Precision Assembly.

Utilize high-resolution force field reconstruction technology for sub-millimeter closed-loop control, reducing assembly loss and errors.

Quality Inspection.

Employ multimodal tactile detection to quantitatively analyze surface morphology and dimensional tolerances, establishing digital quality assessment models to increase yield rates.



Medical & Wellness

Surgical Robots.

Provides multi-modal tactile feedback to measure tissue properties, enabling sub-millimeter operational precision to enhance surgical safety.

Rehabilitation Robots.

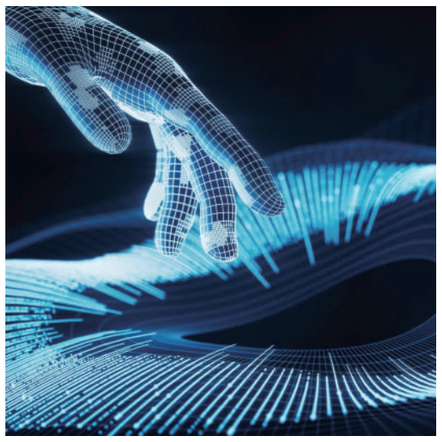
Combines dynamic tactile sensing with biomechanical analysis to optimize personalized rehabilitation plans and improve therapeutic



Agile Logistics

Flexible Sorting, Loading & Unloading.

Real-time material recognition and weight sensing allow dynamic pose and grasp adjustment, enabling damage-free handling and boosting overall smart automation.



Perceptive Interaction

Enables intelligent products to support multimodal inputs, delivering diverse interactive feedback and significantly enhancing the quality of user interaction.

Partners

Embodied Robot

AGIBOT

众擎机器人

GALBOT

X SQUARE ROBOT

TARS 它石智航

XPENG

Industrial scenes

CATL 宁德时代

Haier 海尔

L'ORÉAL

海康威视 HIKVISION

JACK 杰克

SIEMENS

Research Institutes

清華大學 Tsinghua University

北京大學 PEKING UNIVERSITY

Massachusetts Institute of Technology

上海交通大學 SHANGHAI JIAO TONG UNIVERSITY

中國科學院 CHINESE ACADEMY OF SCIENCES

Boston Dynamics

THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

浙江大學 ZHEJIANG UNIVERSITY

Software And Simulator

Multimodal Tactile Visualization Software: XENSE STUDIO

Sensor Compatibility

Supports curved, flat, and fingertip sensors, meeting tactile perception needs across diverse scenarios.

Cross-Architecture &Cross-Platform Support

Compatible with x86 and ARM platform, supporting Linux and Windows operating systems. Provides SDKs to ensure seamless integration across different hardware and software environments.

Integrated Multimodal Perception Algorithms

Precisely calculates tangential slip, surface morphology, and distributed 6-axis forces, providing comprehensive data support for advanced tactile analysis.

Rich Visualization Capabilities

Offers 3D, 2D, and digital twin visualization options, enabling users intuitively understand tactile data.

Data Acquisition and Analysis

Supports recording of sensor signals for post-processing, enabling deeper insights and secondary analysis of tactile data.



Tactile Simulator XENSE SIM

- Supports dynamic and deformation simulation
- Compatible with Isaac Sim platform
- Enabling rapid generation of large-scale simulated datasets



Tactile Data Acquisition Toolchain

- High-Quality Tactile Data
- Lightweight and Open-Source Deployment
- Easy-to-Integrate, Cross-Platform Acquisition System



Technology Ecosystem Collaboration

Technical Ecosystem Collaboration

We consistently uphold the philosophy of industry-academia-research collaborative innovation, constructing a trinity synergy system of 「Fundamental Research – Technology Transformation – Industrial Application」. We have established deep partnerships with leading universities, research institutions, and industry pioneers globally to jointly promote frontier exploration and industrial implementation of tactile perception technology.

University & Research Institution Collaboration: Leading Fundamental Research in Tactile Perception

Through strategic industry-academia-research partnerships, we break through the boundaries of tactile sensing technology. By establishing joint laboratories with top-tier institutions such as Shanghai Jiao Tong University and Peking University, we focus on seven core research directions, including flexible sensing materials, micro-nano photonic devices, neuromorphic tactile algorithms and so on. Leveraging top-tier institutions' cutting-edge study and our engineering implementation capabilities, we accelerate the transformation of technologies from lab to real-world applications.

Industrial Deep Collaboration: Empowering Smart Manufacturing & Industrial Applications

Partnering with industry leaders like Agibot, Siemens, and CATL, we tackle core technologies such as industrial-grade tactile data calibration, multimodal perception system integration and smart manufacturing automation. By addressing typical industrial scenarios like new energy battery assembly and precision mold inspection, we collaborate with partners to systematically validate high-robustness tactile solutions, accelerating the industrialization of tactile technology. Through full-stack development covering "Materials – Devices – Systems – Algorithms," we establish a strong core competitive advantage.

Qualifications & Honors

- IEEE ICRA Best Conference Paper Award (2021)
- Gold Award, China International College Students' Innovation Competition (2023)
- Global Top 100 Open Innovation Companies – Plug and Play China (2024)
- Top 50 Startups with Strongest Proof-of-Concept Capability – Plug and Play China (2024)
- "Future Star" Enterprise – Shanghai Jiao Tong University (2024)
- Premium Tactile Sensor Supplier for Humanoid Robotics Industry Chain – Gaogong Humanoid Robotics (2025)
- Outstanding Growth Award – SJTU Alumni Fund (2025)
- WRC Top 30 Most Promising RoboticsCompanies in China (2025)
- L'Oreal BIG BANG Beauty Tech Innovation Program OPERATION TRACK WINNING COMPANY (2025)