

PDE Agent

From Mathematical Theory to Industrial Revolution
Dedicated to Unleashing the Creative Minds of Engineers Worldwide

A NEW ERA OF AI-POWERED PHYSICS SIMULATION

Zhihong Jeff Xia

Pancoe Professor of Mathematics, Northwestern University

About Our Founder: Professor Zhihong Jeff Xia



Zhihong Jeff Xia

Pancoe Professor at Northwestern University | Expert in Dynamical Systems & PDEs



Academic Peak • Solving a Century-Old Problem

At age 26, solved the century-old "Painleve Conjecture," with results published in *Annals of Mathematics*.



Top Honors • Internationally Recognized

Received the U.S. Presidential Young Researcher Award in 1993; gave a 45-minute invited lecture at ICM in 1998.



Industry Leader • Department Founder

A world-leading expert in dynamical systems and PDEs; served as founding chair of the Mathematics Department at SUSTech.



Pride of the Chinese Community • Masters' Acclaim

Nobel Laureate C.N. Yang praised: "Xia Zhihong is one of the most outstanding alumni of Nanjing University."

Transforming 30+ years of mathematical research into a powerful tool for industry's core challenges — PDE Agent

Market Pain Points: The Dilemma of Traditional Physics Simulation



Slow Speed, Long Cycles

- Traditional CFD/FEA simulations take days or even weeks, making rapid validation difficult.
- Severely delays product R&D iteration, causing companies to miss market opportunities.



High Cost, High Barrier

- Commercial simulation software licenses cost millions of dollars, with high maintenance costs.
- Heavily reliant on scarce simulation experts, creating dual pressure of labor and trial-and-error costs.



Complex Workflow, Low Efficiency

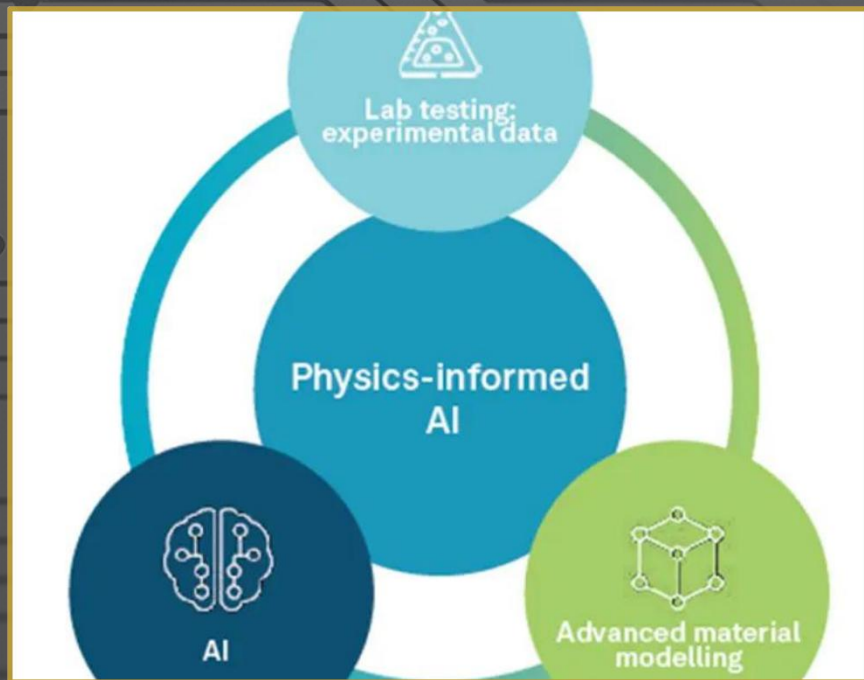
- The entire workflow from problem definition and meshing to result analysis is cumbersome with numerous steps.
- Engineers spend ~80% of their time on repetitive operations, leaving little room for innovation.



Industry Status: Physics simulation has become one of the biggest bottlenecks for high-end manufacturing to accelerate product innovation.

Our Solution: PDE Agent

An AI Physics Simulation Agent Powered by a World-Class Mathematician



PDE Agent deeply integrates Professor Xia's 30+ years of PDE research with cutting-edge AI, breaking traditional simulation bottlenecks and achieving a paradigm shift from "expert-driven" to "intelligence-driven."



Natural Language Driven

Describe requirements in plain language, e.g., "solve 2D NS equations," and the Agent automatically completes the solution.



10-100x Speed Improvement

Breaking computational limits, reducing complex simulation tasks from days to hours or even minutes.



Industrial-Grade Precision

Computational error kept within 1%, fully meeting the stringent standards of industrial engineering applications.



End-to-End Automation

From mesh generation and numerical solving to post-processing reports — fully automated with no manual intervention.

Our Mission: Make world-class physics simulation as easy as using ChatGPT, completely unleashing the creative minds of engineers worldwide.

Core Technology: Dual-Engine Architecture

LLM + Industrial-Grade Numerical Solver



Large Language Model (LLM) - Intelligent Frontend

- Precise Understanding: Accurately interprets complex physical scenarios and requirements described in natural language.
- Code Generation: Automatically converts requirements into executable solver code, simulation scripts, and configuration files.
- Interactive Collaboration: Supports multi-round conversational parameter tuning and solution iteration for a user-friendly experience.



Industrial-Grade Numerical Solver - Robust Backend

- Algorithm Integration: Deeply integrates FEM, FDM, Physics-Informed Neural Networks (PINNs), and other algorithms.
- Industrial Precision: Solving error strictly kept within 1%, validated across multiple real-world industrial scenarios.
- Ultra-High Performance: Supports large-scale distributed parallel computing, handling complex tasks with tens of millions of mesh elements.

This unique "Dual-Engine Architecture" perfectly combines the flexibility and usability of AI with the uncompromising high precision and reliability of physics simulation.

Ecosystem Compatibility: Integrating with NVIDIA PhysicsNeMo

Seamless Compatibility • Zero Migration Cost • Existing User Code Unchanged

PDE Agent — CauchyNet High-Precision Kernel

- Cauchy Integral Formula: Driven PINN solver with rigorous singularity handling
- Singularity-Aware: High-precision interfaces • Thin boundary layers • Multi-physics coupling
- AI Data Centers: Specialized thermal management optimization, compliance-grade precision
- Satellite Thermal Analysis: Orbital radiation heat transfer • Thermal deformation multi-physics scenarios
- O-PINN Ontology Layer: Interpretable • Auditable • Compliance Reporting

CauchyX AI • NVIDIA Inception Member

NVIDIA PhysicsNeMo Ecosystem Infrastructure

- FNO / PINO / GNN: Transformer standard PINN model library
- DGX Distributed Training: Infrastructure (A100/H100) reuse without rebuilding
- VTK / OpenFOAM: Data pipeline • PhysicsNeMo Sym PDE constraints
- 10,000+ Global Engineers • NVIDIA Inception Official Partnership
- Zero User Changes: Existing PhysicsNeMo code remains completely unchanged

NVIDIA Inception Official Partnership Ecosystem

```
import cauchyx <- The only new line users add; transparently takes over high-precision scenarios, PhysicsNeMo apps remain unchanged
```

CauchyX handles high-precision • PhysicsNeMo handles standard scenarios • Shared NVIDIA infrastructure

PDE Agent Ecosystem Map

The Intelligent Operating System for Physics • Unifying PDE, AI, Engineering & Industry

1 COMMERCIAL & PROPRIETARY PDE / PINN / CAE SOFTWARE

AI-PDE / PINN SOLVERS (Key Players & Partners)

NVIDIA Modulus
 Ansys
 COMSOL
 ALTAIR

SIEMENS Simcenter
 NUMECA
 SIMSCALE
 DASSAULT SYSTEMES 3DEXPERIENCE

TRADITIONAL NUMERICAL PDE SOFTWARE (FEM / FVM / FD)

ABAQUS
 MSC Software
 LS-DYNA
 STAR-CCM+

Ansys FLUENT
 STAR-CD
 ...and more

2 OPEN SOURCE PDE / PINN / PHYSICS-AI SOFTWARE & FRAMEWORKS

PINN / PDE AI FRAMEWORKS

DeepXDE (Lu Lu et al.)
 NeurodiffEq
 PyPDE AutoPINN
 NVIDIA SimNet (Open Source)

Physics-Informed Neural Networks
 CauchyNet / Xnet (Cauchy Integral Kernel, Our Core)

OPEN SOURCE PDE SOLVERS (FEM / FVM)

FEniCS Project
 OpenFOAM®
 deal.II
 MFEM

PETSc
 SLEPc
 SUNDIALS

SCIENTIFIC COMPUTING & AI BACKENDS

PyTorch
 JAX
 TensorFlow
 Flax
 OneFlow
 MindSpore

3 HARDWARE ECOSYSTEM (Compute, Chips & Cloud)

AI CHIPS / ACCELERATORS

NVIDIA A100 / H100 L40S
 AMD MI250X MI300
 HUAWEI Ascend 910B
 Cambricon 寒武纪
 Moore Threads 摩尔线程
 Lightelligence Photonic Computing

CLOUD PLATFORMS (Global)

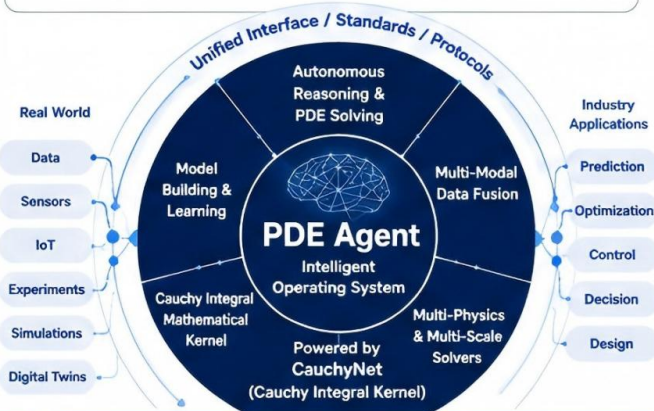
ORACLE Cloud OCI
 aws
 Google Cloud
 Microsoft Azure
 Alibaba Cloud
 Tencent Cloud
 Baidu AI Cloud

SUPERCOMPUTING CENTERS

TOP500 Global
 National Supercomputing Centers (China)
 U.S. NSF Supercomputers
 Oak Ridge National Lab
 Lawrence Livermore National Lab

4 GLOBAL TOP EXPERTS IN PDE / PINN / PHYSICS-AI

PIONEERS OF PINN	MATHEMATICS & PDE GIANTS	INDUSTRY & AI LEADERS
George Karniadakis Brown University	Zhi-Hong Xia Northwestern University	<ul style="list-style-type: none"> NVIDIA Modulus Core Team ANSYS AI Chief Scientists MIT / Caltech Computational Physics Teams DeepMind Physics Team (AlphaFluids) Stanford / Caltech / MIT Researchers
Lu Lu Brown University	Terence Tao UCLA	
Yingyu Li MIT	Camillo De Lellis Princeton University	
Paris Perdikaris UPenn	Yann Ollivier ENS	
Maziar Raissi (Former) DeepMind	Alexandre Chorin UC Berkeley	



5 ACADEMIC INSTITUTIONS & RESEARCH LABS (Collaboration)

Home of Home of PINN & DeepXDE	MIT CSAIL Computational Science Lab	Stanford University Scientific Computing	Caltech Computing & Mathematical Sciences	Princeton University Program in Applied & Computational Math	Berkeley Institute for Data Science
Northwestern University (Xia Group)	ICT, CAS	Academy of Mathematics, CAS	Peking University	Tsinghua University (Yau Center)	

6 INDUSTRY END-USERS & APPLICATIONS (App Store of PDE Agent)

BENEDYO & BATTERY	AEROSPACE	AUTOMOTIVE	SEMICONDUCTOR	CHEMICAL / OIL & GAS / ENVIRONMENT	BIOMEDICAL
<ul style="list-style-type: none"> CATL BYD EVE Energy Tesla Panasonic Samsung SDI 	<ul style="list-style-type: none"> Boeing Airbus AVIC NASA SpaceX Blue Origin 	<ul style="list-style-type: none"> Volkswagen BMW Mercedes-Benz Toyota Li Auto XPENG 	<ul style="list-style-type: none"> TSMC Samsung SMIC 	<ul style="list-style-type: none"> BASF Shell CNPC PipeChina Meteorology 	<ul style="list-style-type: none"> Cardiovascular Blood Flow Tumor Growth Modeling Neural Dynamics
<p>Applications:</p> <ul style="list-style-type: none"> Thermal Runaway SOH / Degradation Electrochemistry BMS Simulation 	<p>Applications:</p> <ul style="list-style-type: none"> Aerodynamics Heat Transfer Multi-physics 	<p>Applications:</p> <ul style="list-style-type: none"> Wind Tunnel Structural Analysis Thermal Management 	<p>Applications:</p> <ul style="list-style-type: none"> Thermal Electromagnetics Lithography Stress / Strain 	<p>Applications:</p> <ul style="list-style-type: none"> Reservoir Simulation Reacting Flow Pollution / Groundwater 	<p>Applications:</p> <ul style="list-style-type: none"> Medical Imaging Drug Delivery Bio-mechanics

7 DATASETS, MIDDLEWARE & VISUALIZATION (Plug into PDE Agent)

DATASETS	TOOLS & VISUALIZATION	MIDDLEWARE & INTERFACES	ONTOLOGY & KNOWLEDGE
<ul style="list-style-type: none"> PINN Benchmarks: <ul style="list-style-type: none"> Darcy Flow Navier-Stokes Heat Conduction Wave Equation Allen-Cahn Burgers' Equation Industrial Sensor Time-Series Data Battery Lifecycle Data CFD Datasets (OpenFOAM Cases) 	ParaView VTK Plotly Tecplot WebGL Three.js	Docker Kubernetes gRPC OpenAPI MaaS Digital Twin Platforms (Unity / Unreal Engine)	Protégé OWL <ul style="list-style-type: none"> Knowledge Graph Engine TBox / RBox / ABox Modeling Ontology Reasoners

8 COMMUNITY, CONFERENCES & OPEN SOURCE

arXiv: PINN / Scientific Computing

NeurIPS / ICML / ICLR AI for Science Tracks

JCP / CMAME / SIAM Journal Top PDE Journals

PINN Workshop AI for Science Global Summit

GitHub Physics-AI Open Source Community

CAE / CFD Forums Industrial Simulation Communities

9 CAPITAL ECOSYSTEM (Investors & Partners)

GLOBAL VENTURE CAPITAL

ANDREESSEN HOROWITZ
 FOUNDERS FUND
 Bessemer Venture Partners
 OCI Capital

CHINA & ASIA INVESTORS

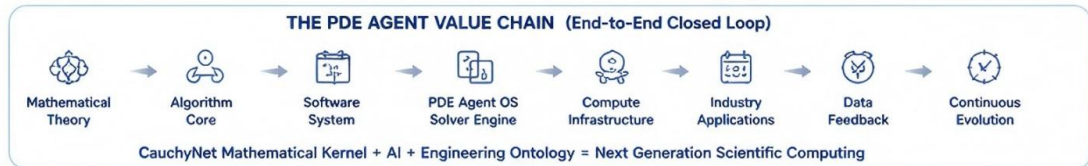
SEQUOIA CAPITAL CHINA
 Hillhouse Capital
 矩阵资本
 派拓资本

INDUSTRY & STRATEGIC FUNDS

CATL Capital Industry Funds
 Government Guidance Funds
 Cross-Border Funds & Partners

GLOBAL PRESENCE

Cayman Structure
 USD Funds
 Global Market Access Strategic Partnerships



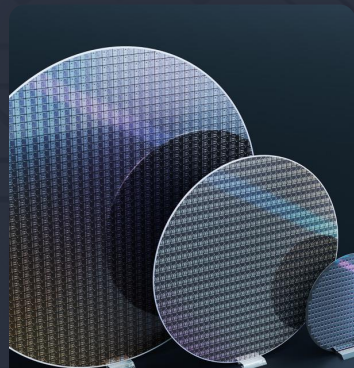
OUR CORE ADVANTAGES

Mathematical Breakthrough (CauchyNet)	High-Dimensional Ontology & Knowledge Graph	Multi-Physics & Multi-Scale Solvers	Autonomous Agent Reasoning	Industrial-Grade Applications	Ecosystem Integration
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Our Vision

To become the iPhone of the PDE / Physics-AI era, connecting all software, hardware, data, experts and industries.

Target Application Scenarios: Reshaping High-End Manufacturing



Chip / Semiconductor

Challenge: Chip thermal simulation, electromagnetic interference (EMI), high power consumption analysis

Value: Reduces chip thermal simulation from 3 days to 10 minutes, dramatically accelerating chip design and tape-out iteration.



Automotive / Autonomous Driving

Challenge: Complex aerodynamic simulation, battery thermal management, full-vehicle structural analysis.

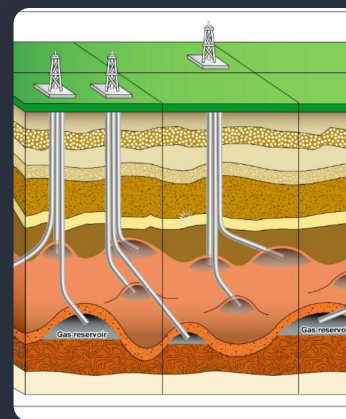
Value: Complete full-vehicle aerodynamic simulation in just 1 hour, significantly improving EV range and passive safety.



Aerospace

Challenge: Rocket-level aerodynamic analysis, extreme environment thermal protection simulation, structural vibration testing.

Value: Rocket re-entry thermal simulation reduced from 2 weeks to 2 hours, accelerating reusable Starship development.



Energy / Finance

Challenge: Large-scale reservoir numerical simulation, high-dimensional Black-Scholes option pricing.

Value: Compresses high-precision reservoir simulation from 1 week to 1 day, significantly optimizing resource extraction and capital allocation efficiency.

Target Application: Chip / Semiconductor

Empowering Next-Generation Chip Design: From Simulation Bottleneck to Innovation Engine

Thermal management and EMI in chip design are core challenges that determine product performance and yield. Traditional physics simulation relies on expensive computing clusters, severely limiting R&D iteration speed and design space exploration.



Ultimate Speed

Thermal simulation time
from 3 days → 10 minutes



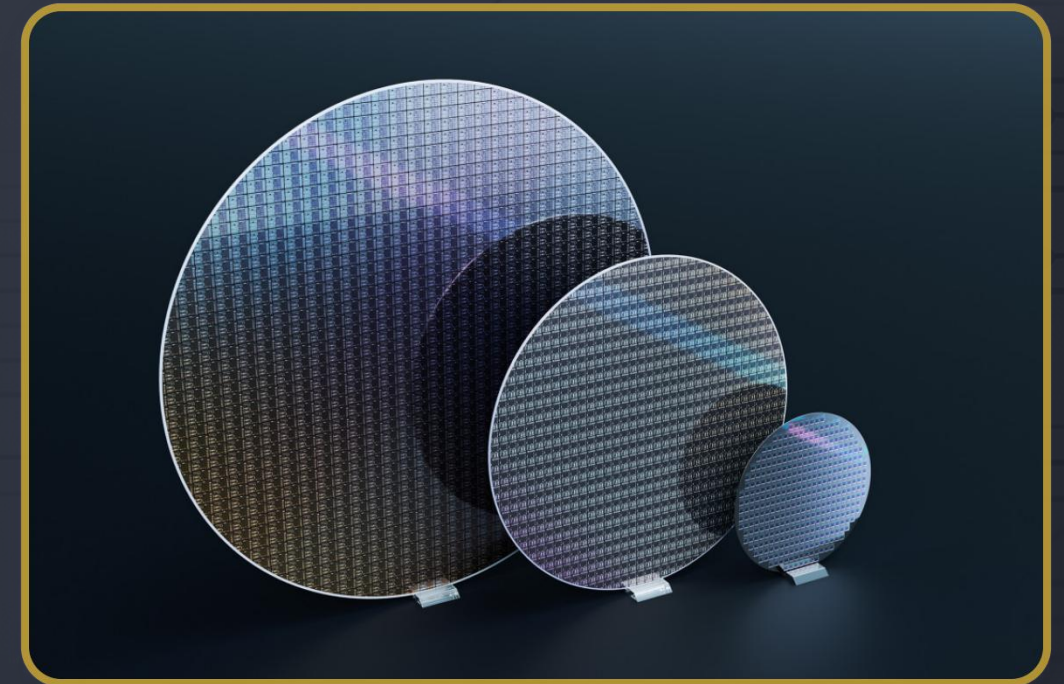
Cost Optimization

Total cost reduced
90%
(compute + labor)



Unleash Innovation

Large-scale
parameter sweeps
Explore more design possibilities



TARGET CLIENTS

Cadence • Synopsys • Intel



Target Application: Automotive / Autonomous Driving



Target Benchmark Clients

PDE Agent optimizes full-vehicle aerodynamic design and battery simulation, dramatically shortening development cycles.

Accelerating Electrification and Intelligentization

Aerodynamics determines range limits; battery thermal management is crucial for vehicle safety. PDE Agent provides automakers with an ultra-high-performance simulation computing foundation, breaking traditional development bottlenecks.



Ultimate Efficiency

Aerodynamic simulation
1 week → 1 hour



Safety First

Rapidly complete battery thermal runaway simulation
Optimize thermal management systems



Rapid Iteration

Supports large-scale parallel simulation
Accelerate new model time-to-market

Target Clients: Tesla • Waymo • NIO • GM • Apple

Target Application: Aerospace

Pushing the Boundaries of Space Exploration

Rocket aerodynamics, thermal protection, and structural analysis are the most complex and critical aspects of aerospace engineering. PDE Agent provides industry leaders like SpaceX with powerful HPC simulation support to solve complex engineering challenges in extreme environments.



Ultra-Fast Simulation

Rocket re-entry thermal simulation reduced from 2 weeks to 2 hours — a 100x efficiency improvement.



Accelerated Iteration

Supports large-scale parameter sweeps and multi-physics analysis, accelerating technical validation of revolutionary products like Starship.



Ultimate Reliability

Provides high-precision simulation capabilities, accurately predicting performance in extreme environments to ensure mission success.



Target Clients: SpaceX • Blue Origin • NASA

Target Market & Customers

We Target Silicon Valley's Most Valuable Customer Segments

01 Deep-Tech Companies

- 🔧 Chip / Semiconductor: NVIDIA, Intel, Cadence, Synopsys
- 🚗 Smart Automotive: Tesla, Waymo, NIO, Apple
- 🚀 Commercial Space: SpaceX, Blue Origin
- ☁️ High-Performance Cloud: Google Cloud, AWS, Rescale

Profile: Compute-intensive, with extremely high requirements for solving speed and precision.

02 Engineering Software Giants



Key Players: ANSYS, MathWorks (MATLAB), Dassault Systemes

These companies face the critical challenge of transitioning from traditional numerical computing to AI-driven simulation. We are not only the ideal technology partner but also a highly strategic acquisition target.

03 Top Research Institutions



Core Network: MIT, Stanford, Caltech, and other world-leading research universities and laboratories.

"Zero-code PDE solving" is a high-frequency core need in research. Deep collaboration with these institutions provides irreplaceable academic authority for our product.

Business Model

Flexible Business Model to Meet Diverse Customer Needs



Subscription (Primary Revenue Source)

- Standard Edition: \$50,000/year for SMEs and teams, providing complete core functionality.
- Enterprise Edition: \$200,000/year for large enterprises, offering advanced analytics, private deployment, and dedicated support.



Custom Project Development

- Deep algorithm and feature customization for specific industries or clients such as aerospace and automotive.
- Pricing based on development complexity and timeline; project initiation fees start at \$500,000.



API Usage Billing

- Open high-performance PDE solving and AI inference APIs to empower third-party developers and platforms.
- Flexible tiered pricing model, billed by call volume or traffic.



Channel Partnerships & Technology Licensing

- Industry Giant Partnerships: Deep integration as AI engine in engineering software like ANSYS with technology licensing.
- Cloud Provider Ecosystem: Listed on AWS/Azure Marketplace with revenue sharing with partners.

Competitive Advantages: Why Us?



Academic Authority

- Founder Professor Zhihong Jeff Xia
A world-class mathematician providing unparalleled theoretical depth and credibility, establishing a strong theoretical moat.
- Top Academic Endorsement
Deep ties with MIT, Stanford, and other world-class universities, with ongoing cutting-edge research collaboration to ensure long-term technological leadership.



Technical Leadership

- ◆ Dual-Engine Hybrid Architecture
Perfectly combines the generative flexibility of LLM with the computational rigor of numerical solvers.
- ◆ Industrial-Grade Validated Precision
Computational error strictly controlled within 1%, fully meeting professional engineering application requirements.
- ◆ Natural Language Interaction
No specialized coding skills required, significantly lowering the barrier for engineers and improving efficiency.



Market Advantage

- Blue Ocean Market, First-Mover Advantage
There are currently no mainstream commercial competitors with equivalent technical depth. We entered first and defined the technical standards, seizing a valuable market window.
- Locking in High-Value Customers
Already successfully penetrated top Silicon Valley tech companies and leading manufacturers, with very high contract values and strong customer retention.

Team Introduction

World-Class Mathematics & Engineering Team



Zhihong Jeff Xia

Founder & Scientific Advisor
Pancoe Professor at Northwestern University
World-class mathematician, expert in dynamical systems



CEO

Former President of a Nasdaq-listed company
Deep expertise at the intersection of physics and AI; led multiple core algorithm R&D projects; author of Engineering Ontology.



Engineering Lead

Former AWS Senior Engineer
Years of AI simulation software development experience; proficient in high-performance computing and architecture design.



Product Lead

Former YC Startup Product Manager
Skilled at transforming cutting-edge technology into commercial value with deep understanding of user needs.

" Our team perfectly integrates world-class mathematical theory, cutting-edge AI technology, and extensive industrial practice experience "

Thank You

Join us in revolutionizing the world of physics simulation.
With PDE Agent, Unleash the Creative Minds of Engineers Worldwide

CauchyX AI

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