sNoise Research Laboratory

Unleashing AI with Fractional Calculus Toolboxes

sNRL

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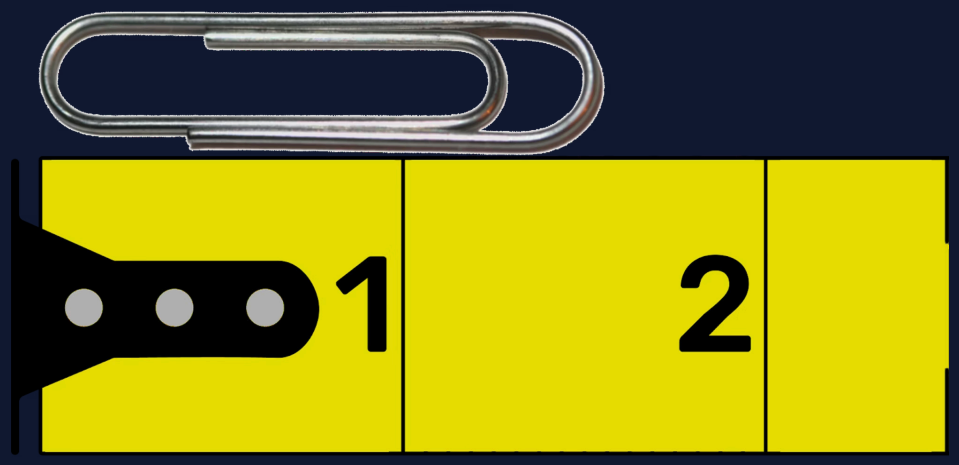
v19.INV.24SEP2025

AI's Mathematical Barrier

AI's Integer Roots in Traditional Calculus



What is the length of the paperclip?

17th Century Mathematics ≠ 21st Century AI

- Today's AI is shackled by 17th-century Traditional Calculus, which functions like a ruler marked only with whole numbers governing its internal architecture.
- Current AI, based on traditional integer-order calculus, lacks precision for complex systems with non-linear dynamics and memory effects. This causes approximations that impair decision-making, restrict adaptability to changing environments, undermine predictive capabilities, and diminish real-time effectiveness hindering AI's full potential.

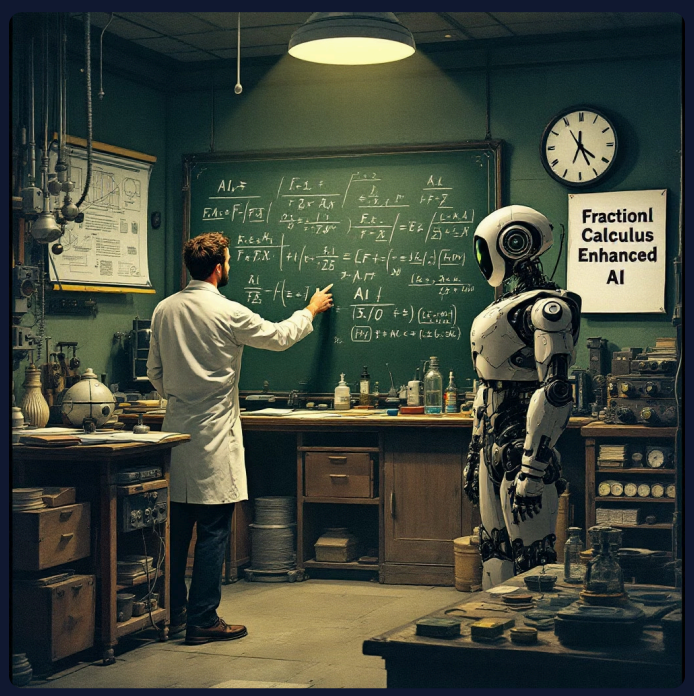
Untapped AI Potential

- This gap in advanced mathematical tools limits opportunity for innovation and contributes to the current bottleneck in AI.

Breaking Through with Fractional Calculus (FC)

AI's Enhanced Accuracy in Fractional Calculus

With fractional resolutions, we can accurately measure the exact length at 1 9/16 of an inch.



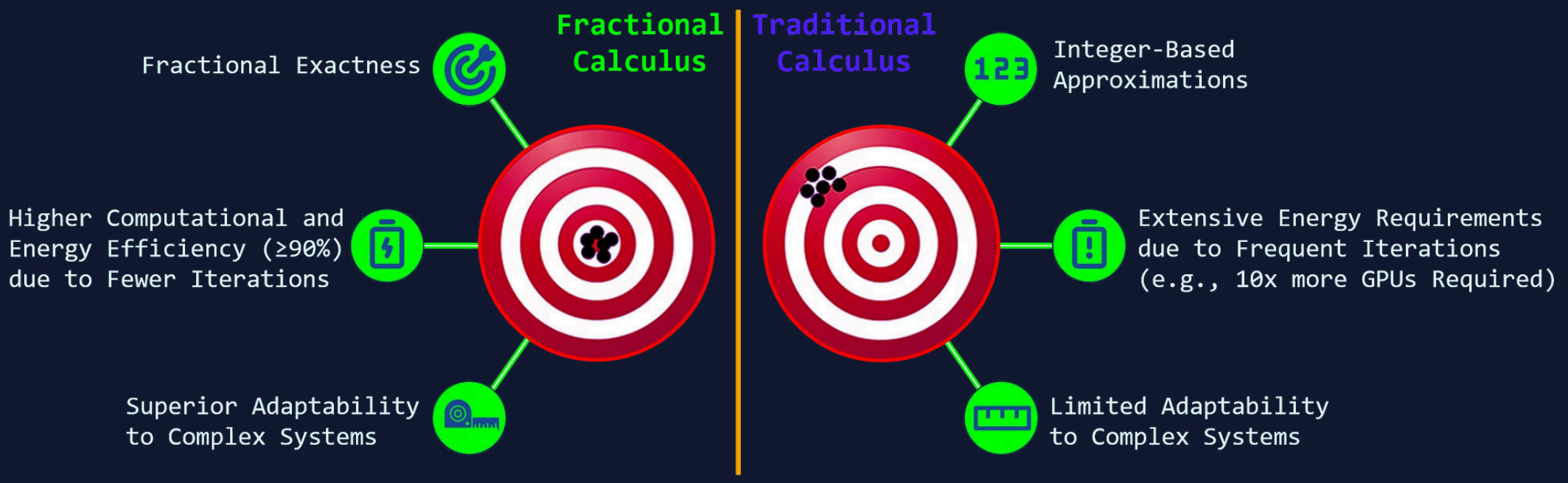
Solution

- 21st-century Fractional Calculus (FC) with a near-infinite-fractional-resolution ruler and fully adjustable operators enhances the precision and accuracy of AI's internal architecture, mirroring how fractals revolutionized graphics.
- sNRL holds four foundational utility patents for fractional calculus-based algorithms in digital signal processing and fractional order control systems, which lay the foundation to create FC toolboxes as the industry standard upon which AI is built for a $1.47 trillion global market by 2030.

Potential and Impact

- This enhanced precision and accuracy in operations enables capabilities Traditional Calculus cannot achieve, transforming AI and signal processing, while unlocking a massive untapped opportunity.

Upgrading AI with sNRL's Fractional Calculus Toolbox



FC Toolboxes Enhance AI Training and Inference

1

Optimizing Backpropagation

- Backpropagation adjusts AI weights using Traditional Calculus to minimize errors during training, a key process for learning.
- FC optimized weight adjustments enable improved accuracy and precision enhancing anomaly detection.

2

Enhanced Inference

- Augment inference through preprocessing, feature extraction, post-processing, edge optimization, and hybrid architectures making it ideal for real-time, signal-intensive AI applications.
- With fewer and faster calculations, this process also reduces energy expenditure and the number of GPUs required.

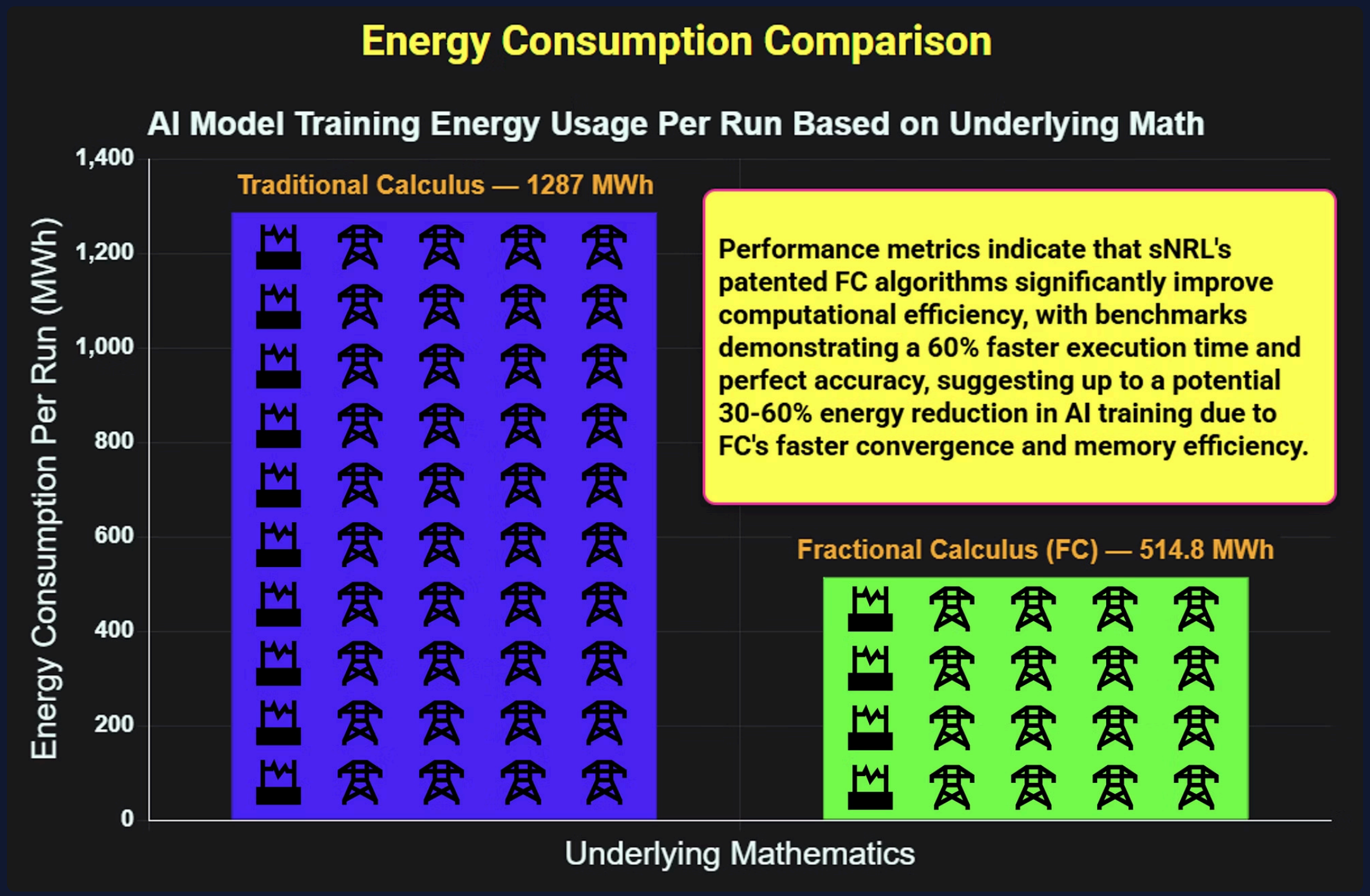
3

Performance Advantage and Market Impact

- sNRL's patented Plug-and-play FC toolboxes can train and scale AI deployment across industries by integrating efficient backpropagation into any AI system (e.g. LLM).
- sNRL's FC toolboxes can also function as Agents in an agentic AI system making inference more robust and energy efficient allowing for anyone to use fractional calculus without specialized knowledge.

Transforming Datacenter Economics:

Power Reduction and Profit Potential



Potential Scale

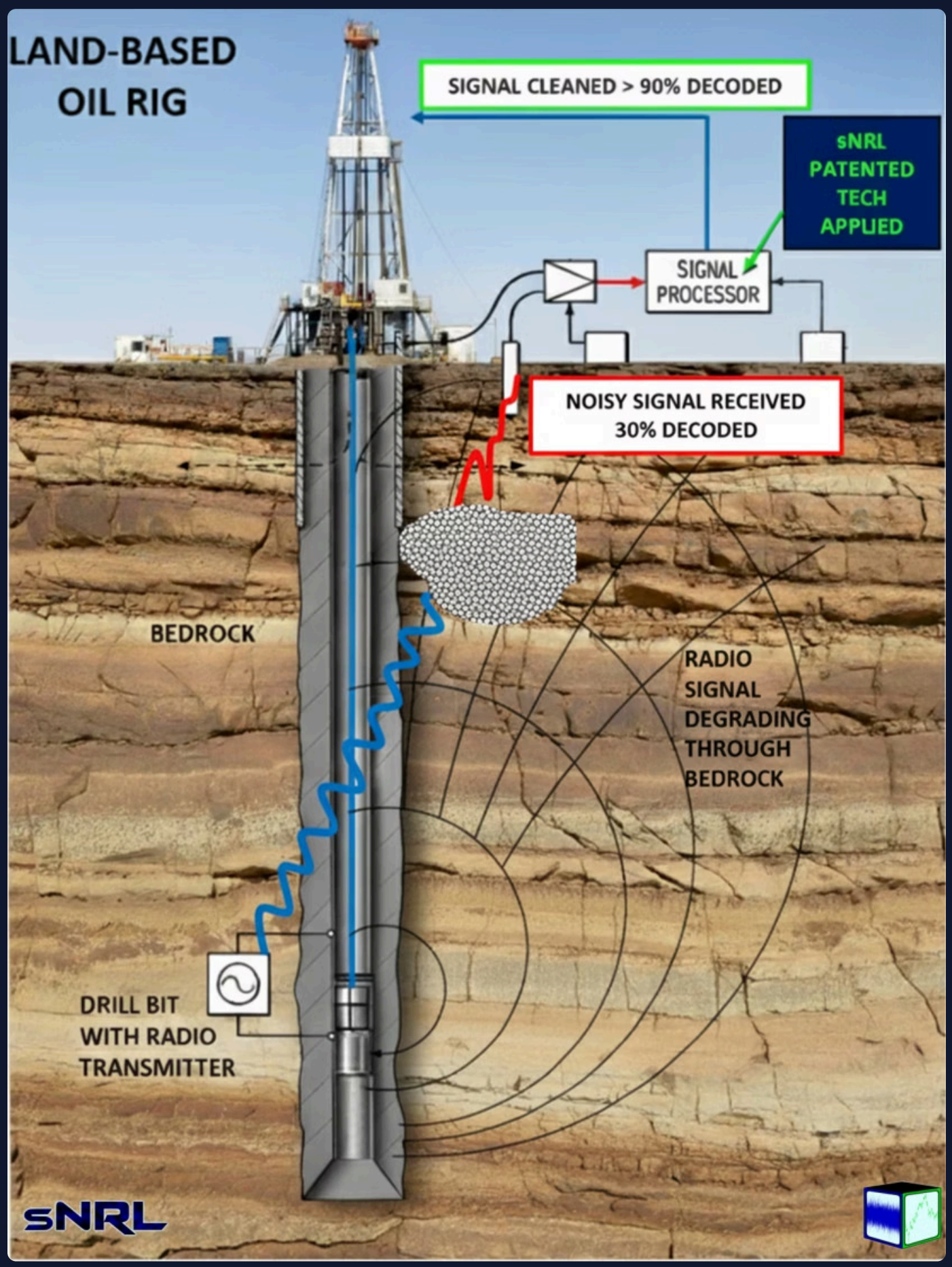
Up to $600M annual savings for a $1B spender like OpenAI, based on the potential for up to 60% energy reduction with sNRL's FC toolboxes optimizing computation time[12].

Licensing Revenue

15% of cost savings (e.g., $90M from OpenAI's $600M) ensures scalability, driving significant recurring income across multiple clients via innovative FC toolboxes.

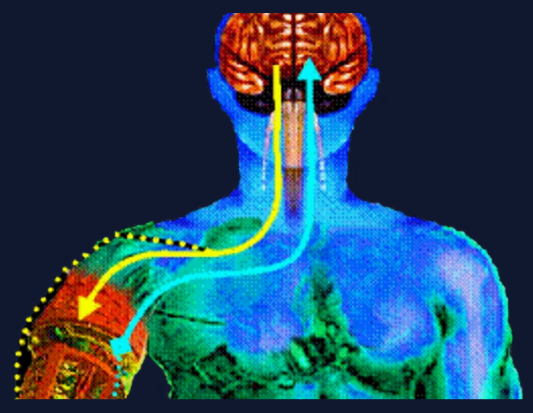
sNRL's FC Toolboxes Act as AI Agents Across Industries for Rapid Profitability

Oil Exploration Proof of Concept



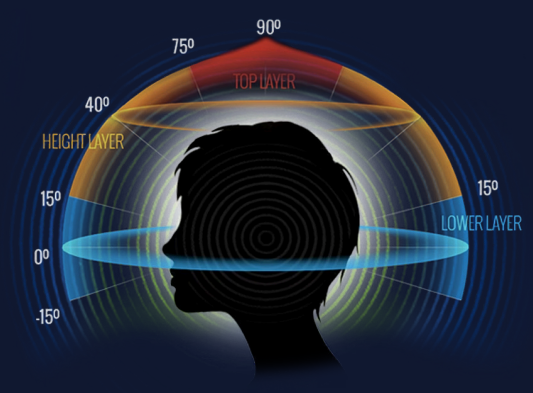
FSDSP achieves over 90% decode rate effectively removing in-band noise, improving raw telemetry data quality (30% raw vs 63% state-of-art), reducing re-boring costs with the potential to save millions.

More Proof-of-Concepts

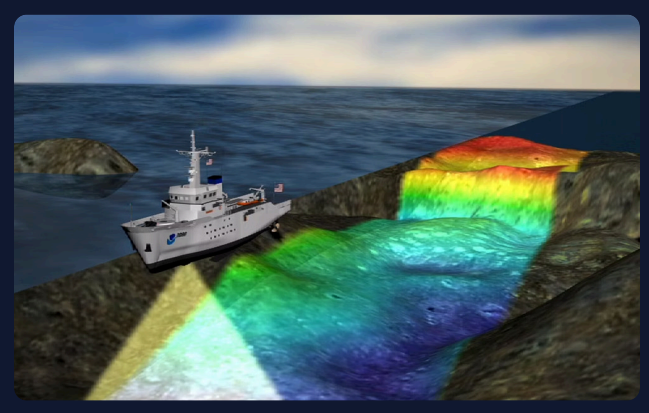


Medical Breakthroughs

Deepfake & Media Security



Audio/Video/Data Processing



SONAR/RADAR Signal Processing

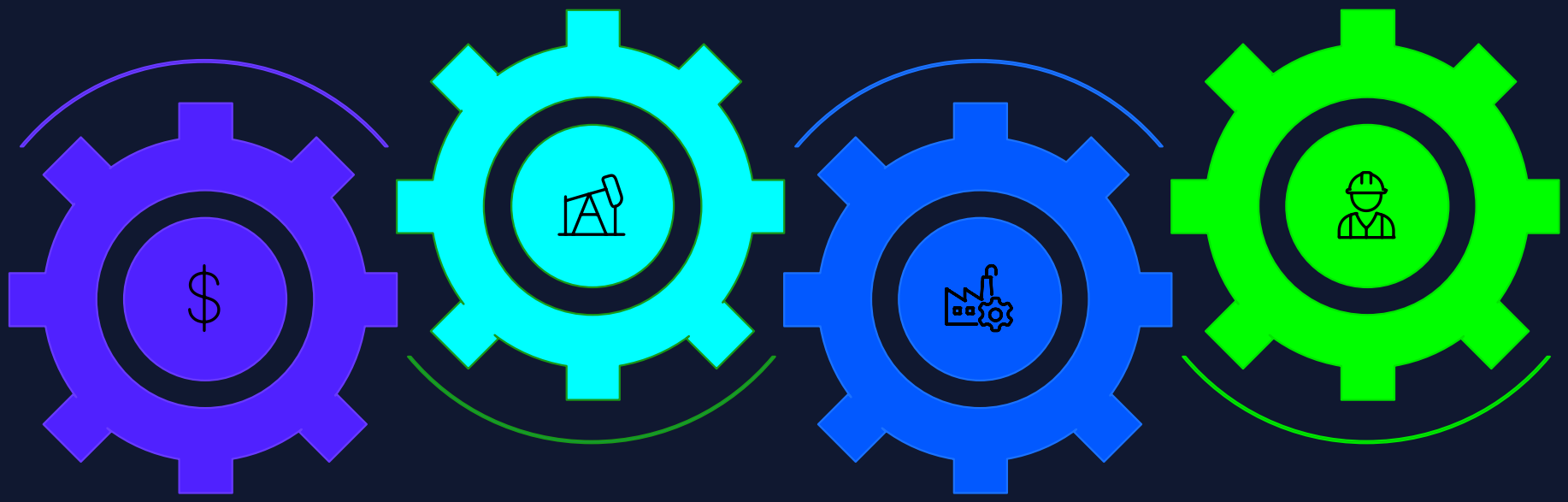
Profitability for the Oil Exploration AI Agent

$3B Annual Potential Savings

For 1,501 total land-based rigs worldwide.

$45M Annual Licensing Revenue

With 10% market penetration.



~$2M Saved Per Rig

Eliminate decoding errors.

$450M Total Cost Savings

Charge 15% licensing fee.

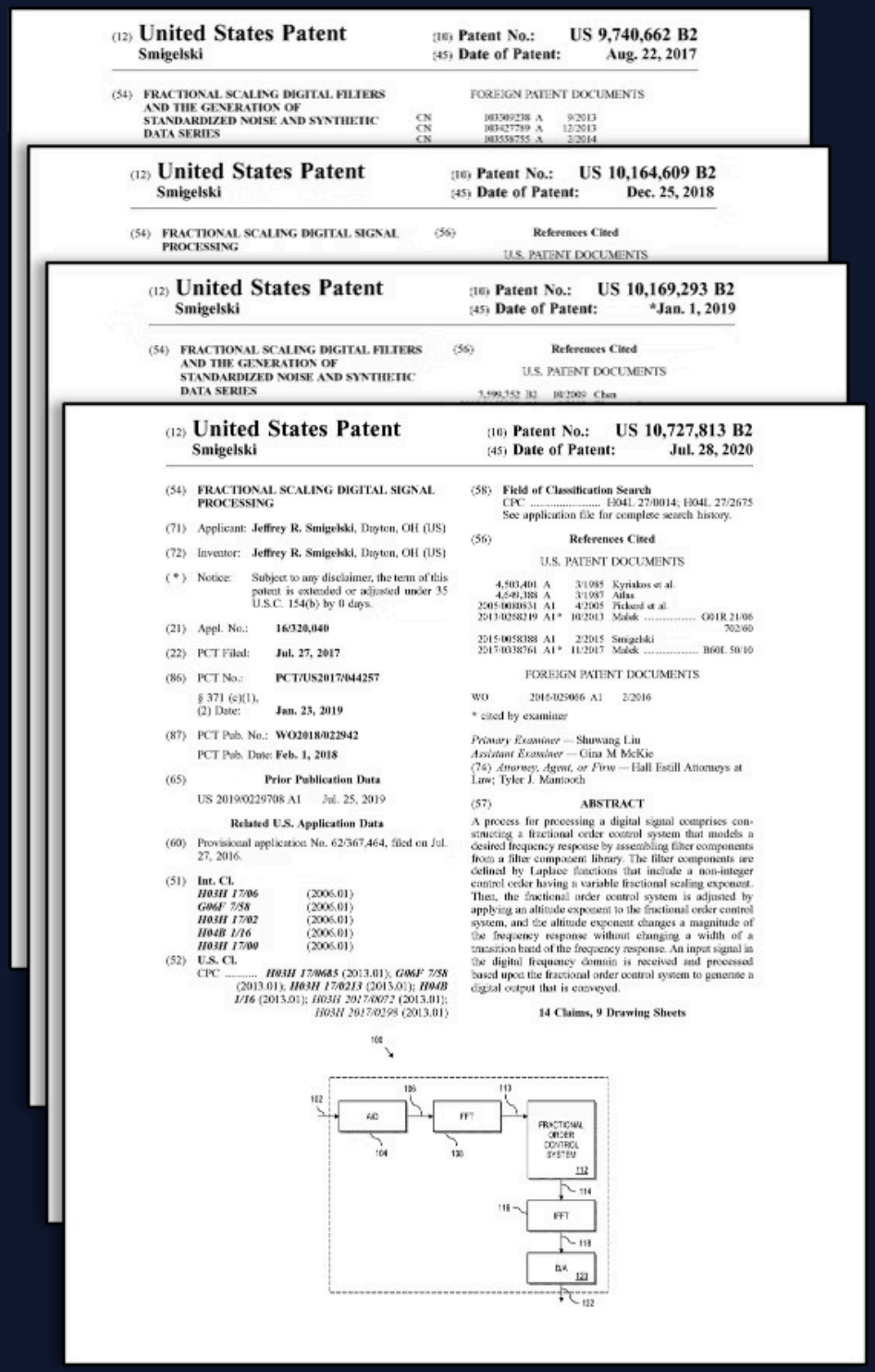
sNRL Holds Four Exclusive U.S. Patents for FC Technology

FC Building Blocks for Advanced AI and Control

All patents awarded to and held by sNRL form a core foundational platform technology that enables Fractional Calculus Algorithms, applicable to diverse data types, signals, and control systems, facilitating seamless integration into AI applications.

Benefits of Fractional Calculus:

- Digital Signal Processing: Filter and clean noise from signals for clear data transmission.
- Fractional Order Control Systems: Enhanced system responsiveness and stability allows quicker recovery from disturbances.
- Next-Level Enhanced AI: Integration of fractional calculus (FC-AI) directly into AI optimizes pre-training, improves inference reasoning, and supports advanced decision-making.



(12) **United States Patent**
Smigelski

(10) **Patent No.: US 9,740,662 B2**
(45) **Date of Patent: Aug. 22, 2017**

(54) **FRACTIONAL SCALING DIGITAL FILTERS AND THE GENERATION OF STANDARDIZED NOISE AND SYNTHETIC DATA SERIES**

FOREIGN PATENT DOCUMENTS

CN 103369238 A 9/2013
CN 103427789 A 12/2013
CN 103558755 A 2/2014

(12) **United States Patent**
Smigelski

(10) **Patent No.: US 10,164,609 B2**
(45) **Date of Patent: Dec. 25, 2018**

(54) **FRACTIONAL SCALING DIGITAL SIGNAL PROCESSING**

(56) **References Cited**
U.S. PATENT DOCUMENTS

(12) **United States Patent**
Smigelski

(10) **Patent No.: US 10,169,293 B2**
(45) **Date of Patent: *Jan. 1, 2019**

(54) **FRACTIONAL SCALING DIGITAL FILTERS AND THE GENERATION OF STANDARDIZED NOISE AND SYNTHETIC DATA SERIES**

(56) **References Cited**
U.S. PATENT DOCUMENTS

(12) **United States Patent**
Smigelski

(10) **Patent No.: US 10,727,813 B2**
(45) **Date of Patent: Jul. 28, 2020**

(54) **FRACTIONAL SCALING DIGITAL SIGNAL PROCESSING**

(71) Applicant: **Jeffrey R. Smigelski**, Dayton, OH (US)
(72) Inventor: **Jeffrey R. Smigelski**, Dayton, OH (US)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
(21) Appl. No.: **16/320,040**
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(86) PCT No.: **PCT/US2017/044257**
§ 371 (c)(1),
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PCT Pub. Date: **Feb. 1, 2018**
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Related U.S. Application Data
(60) Provisional application No. 62/367,464, filed on Jul. 27, 2016.
(51) **Int. Cl.**
H03H 17/06 (2006.01)
G06F 7/58 (2006.01)
H03H 17/02 (2006.01)
H04B 1/16 (2006.01)
H03H 17/00 (2006.01)
(52) **U.S. Cl.**
CPC ***H03H 17/0685*** (2013.01); ***G06F 7/58*** (2013.01); ***H03H 17/0213*** (2013.01); ***H04B 1/16*** (2013.01); *H03H 2017/0072* (2013.01); *H03H 2017/0298* (2013.01)
(58) **Field of Classification Search**
CPC H04L 27/0014; H04L 27/2675
See application file for complete search history.
(56) **References Cited**
U.S. PATENT DOCUMENTS

4,503,401 A 3/1985 Kyriakos et al.
4,649,388 A 3/1987 Atlas
2005/0080831 A1 4/2005 Pickard et al.
2013/0258219 A1* 10/2013 Malek G01R 21/06 702/60
2015/0058388 A1 2/2015 Smigelski
2017/0338761 A1* 11/2017 Malek B60L 50/10

FOREIGN PATENT DOCUMENTS

WO 2016/029086 A1 2/2016

* cited by examiner

Primary Examiner — Shuwang Liu
Assistant Examiner — Gina M McKie
(74) *Attorney, Agent, or Firm* — Hall Estill Attorneys at Law; Tyler J. Mantooth

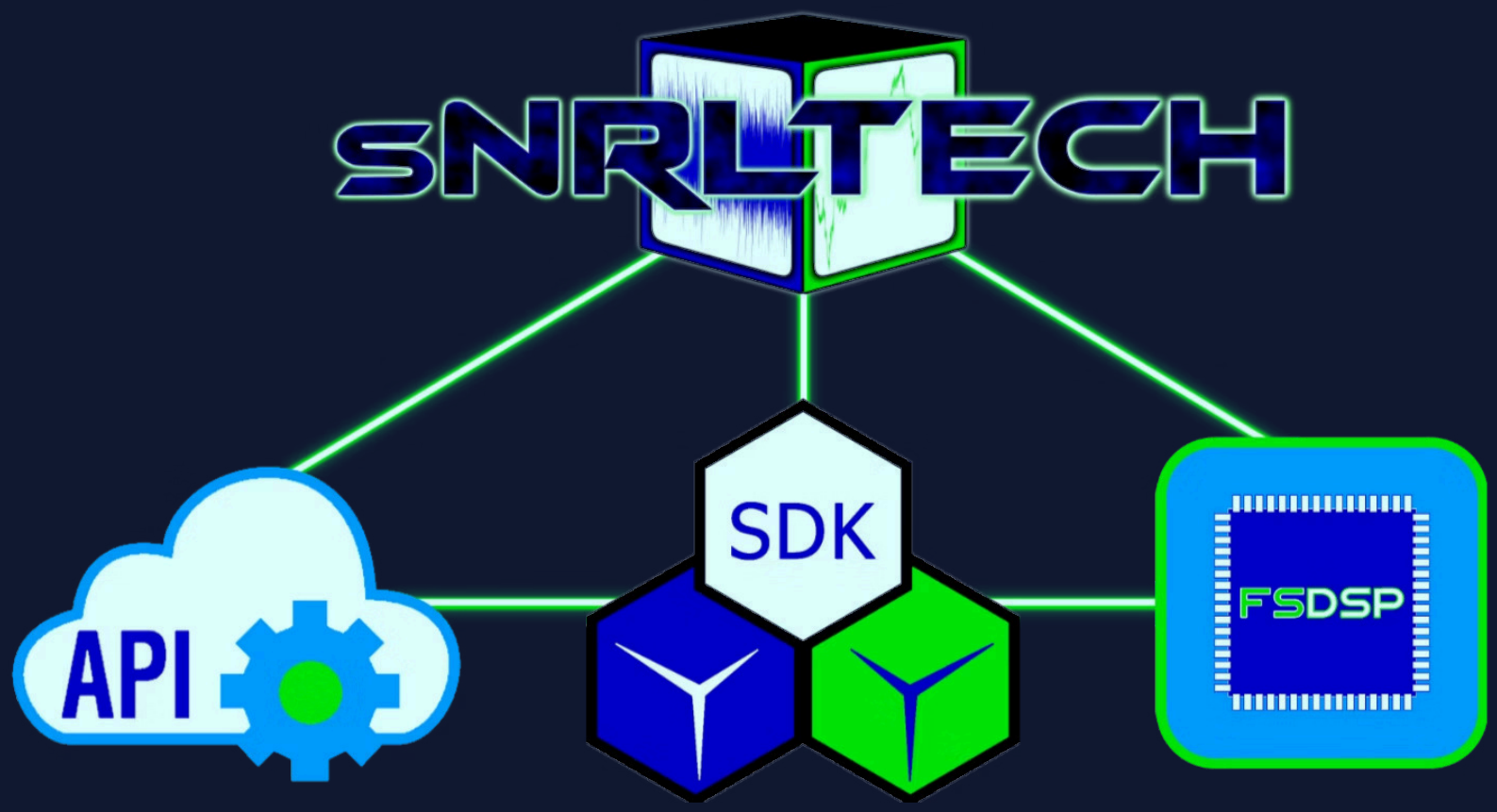
(57) **ABSTRACT**

A process for processing a digital signal comprises constructing a fractional order control system that models a desired frequency response by assembling filter components from a filter component library. The filter components are defined by Laplace functions that include a non-integer control order having a variable fractional scaling exponent. Then, the fractional order control system is adjusted by applying an altitude exponent to the fractional order control system, and the altitude exponent changes a magnitude of the frequency response without changing a width of a transition band of the frequency response. An input signal in the digital frequency domain is received and processed based upon the fractional order control system to generate a digital output that is conveyed.

14 Claims, 9 Drawing Sheets

Additional algorithms enhancing our patents are already in development and ready to file as provisional patents.

Business Model: Revenue and Licensing



Revenue Streams

Data Equalizer App (sNRLTECH):

- Commercial and Consumer access through the app, featuring a subscription-based model with tiered access, metrics, and licensing for designing, implementing, and building **AI Agents** that utilize FC-AI Toolboxes.

FC-AI Toolboxes:

- Scalable solutions for AI systems, providing libraries via **API** or **SDK** that developers use to build more efficient **AI internal architectures** and applications.

Licensing Structure

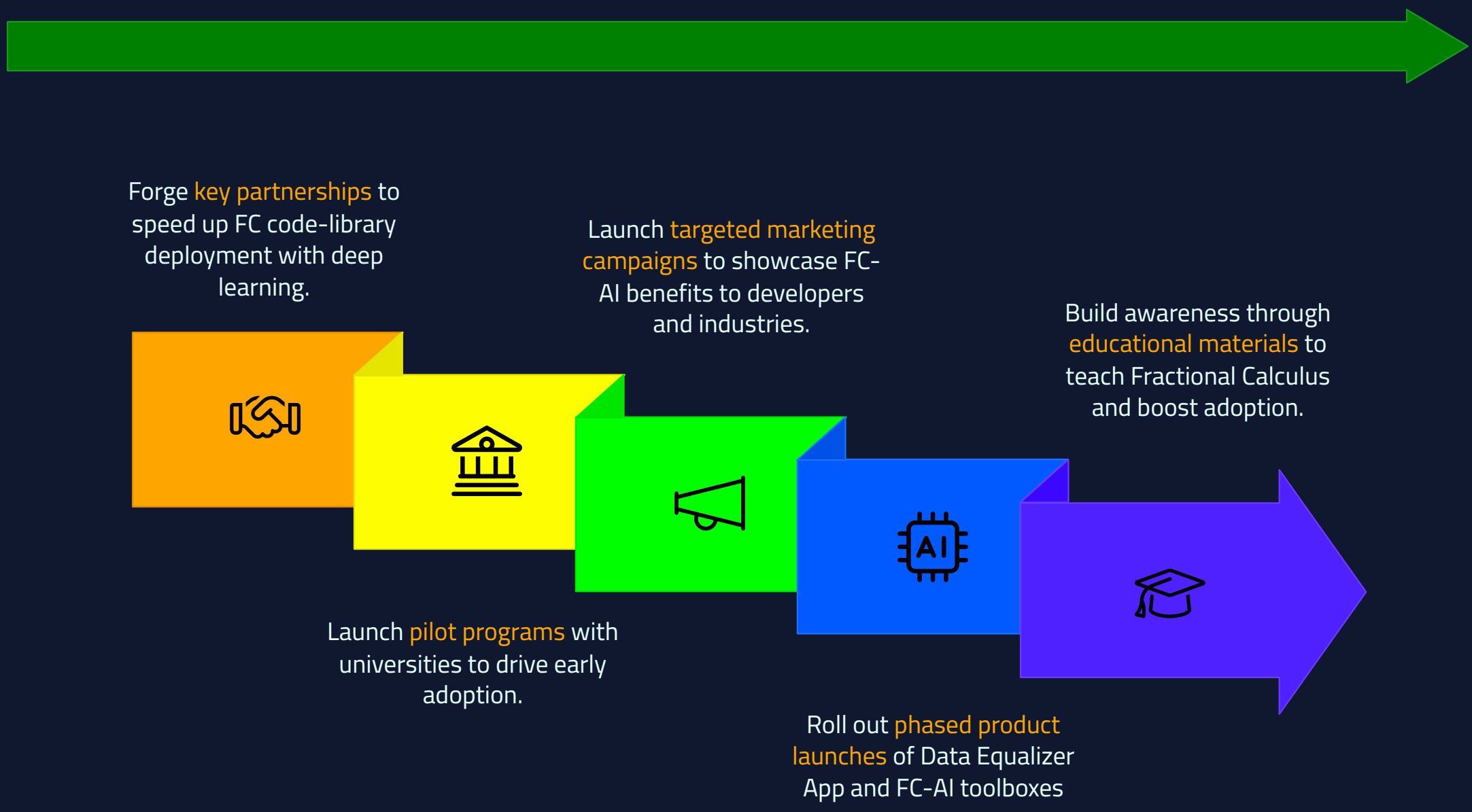
Flexible Pricing:

- Amount and Type of Data Processed
- Cost Savings to Industry or Field-of-use
- Specific Use-Cases (e.g., drill rigs).

Tiered Access Models:

- Developer License
- Commercial License
- Educational/R&D License

Go-to-Market Strategy: First-mover Advantage



Expanding Accessibility and Market Reach for FC-Based AI

- **Objective:** sNRL's Data Equalizer App lowers barriers for scientists, engineers, and students to adopt advanced FC-based AI, leveraging our expertise and first-mover advantage to drive widespread use.
- **High-Impact Target Markets:** AI developers, data scientists, research institutions, government, and for-profit industries: oil-field services, neuroscience, audio processing, quantum sensing, autonomous vehicles, robotics, UAVs.

sNRL Sets the FC-AI Industry Standard for Competitors

4

Exclusive Patents

Foundational U.S. utility patents for fractional calculus algorithms in DSP and control systems

100x-300x

Signal Superiority

100-300x better Signal fidelity and SNR vs. traditional methods.

90%+

Decode Rate

In borehole telemetry vs. 63% for traditional DSP, reducing errors and costs

First-Mover Advantage

No other companies are known to be developing *fractional calculus libraries* for digital signal processing, systems on a chip, or AI toolboxes utilizing fractional calculus. This positions sNRL well ahead of the curve as a **pioneer in this foundational technology**, securing a strong foothold in the market.

Market Validation

Validated proof-of-concepts across diverse fields including audio, medical devices (e.g., magnetocardiography, electroencephalography for Alzheimer's), geophysics, neutron flux density data from nuclear reactors, software-defined radio spectrum division, tide gauge data, sunspot data, nystagmus events in concussions, speech synthesis, and more.

In all cases, a marked improvement in signal over noise was noted when FSDSP was applied.

Our Visionary Team

Jeffrey Smigelski, Ph.D.

Founder | CEO | Inventor

FC Pioneer & Patent Holder

Dave Sonntag, Ph.D.

Chief Technology &

AI Integration Officer

Darshan Vyas, MD FACS

COO | Board Chair | Physician

Tim Buchenroth

Business Development & Marketing

Alex Kong

Senior Software Developer

Financial Projections & Market Opportunity

$325.28B

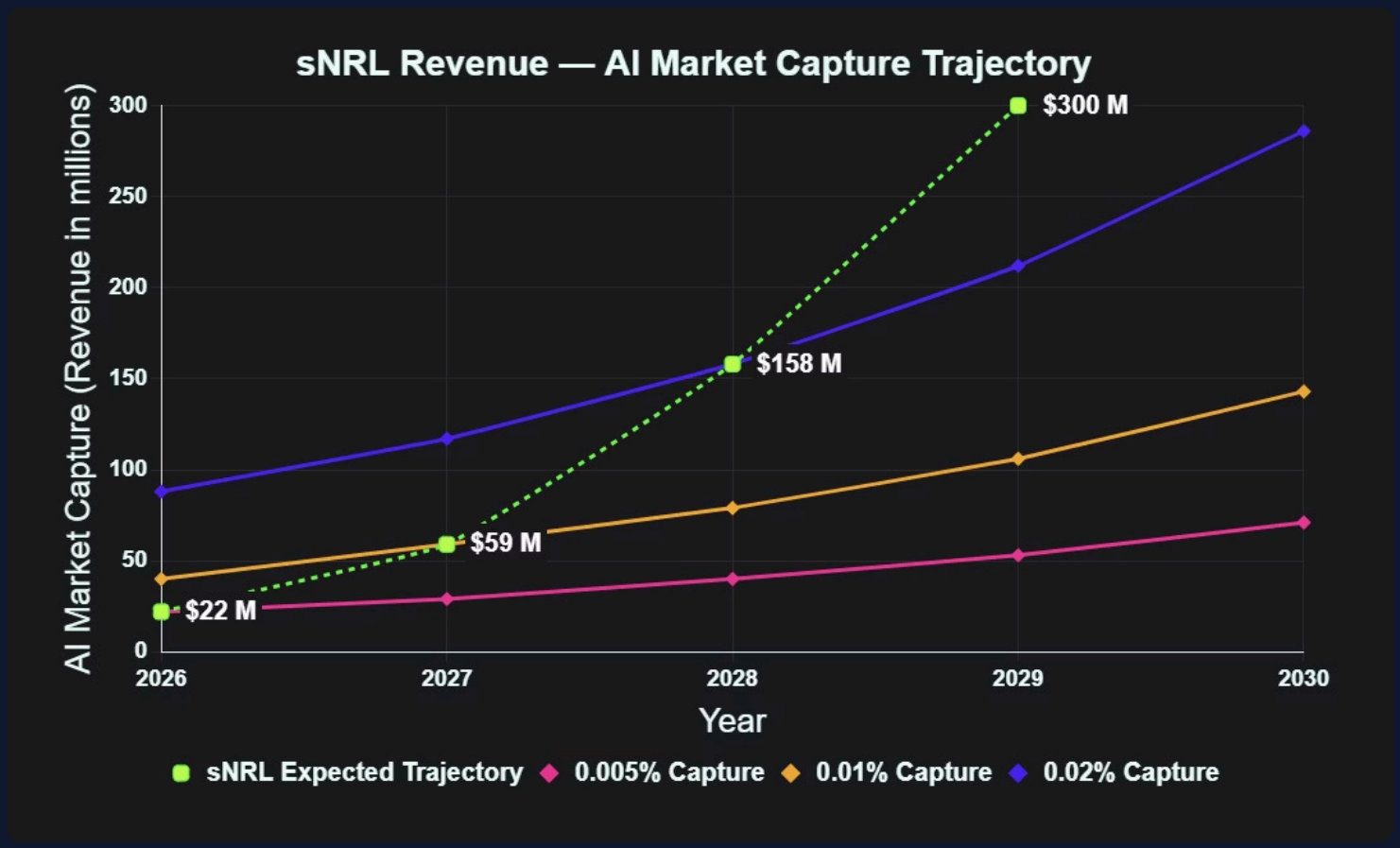
2025 Global
AI Market

CAGR 34.39%

$1.47T

Total Global
AI Market

Projected by 2030



Σ

sNRL anticipates achieving profitability within 18-24 months of launch.

This projection is based on the release of our first commercial products (App, API/SDK with FC-AI toolbox) within the first year, followed by the rollout of additional products across various sectors. Our offerings will leverage AI Fractional Scaling Digital Signal Processing, targeting applications such as AI for deepfake detection in video and audio, AI-enhanced medical diagnostics in biometrics, cardiology, and neuroscience, AI-enhanced oil exploration, and quantum sensing.

sNRL Roadmap to Market Leadership

Current Status

Bootstrapped (~$1M to date),

Awarded four U.S. utility patents (priority 2013).

Validated Proof-of-Concepts across diverse industries,

MATLAB code developed and ready for scaling.

Q1-Q2 2026

Recruit and train specialized talent in FC and AI

Build FC-AI Toolboxes for AI Architectures

Fast-Track Data Equalizer App and SDK/API Development

Begin industry partnerships

Q3 2026

Pilot program (e.g., oil, medical, video/audio sectors)

Marketing and Develop beta program launch

First commercial license

Q4 2026

0.005% Market Penetration

$22M revenue

App, API/SDK public release

Scalable FC-AI solutions

2027

0.01% Market Penetration

$59M revenue

Seize the Opportunity: Invest in the Future with sNRL

The Ask

Seeking **$4.5M** pre-seed funding,
to accelerate the commercialization
of FC-AI and establish market leadership.

Join the FC-AI Frontier

We welcome investment, partnerships, and collaborations

to advance the future of AI with Fractional Calculus.

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Proprietary Technology & Contact

Protected Innovations

sNRL holds foundational intellectual property rights for Fractional Scaling Digital Signal Processing (FSDSP), Fractional Scaling Digital Filters, and Fractional Order Control Systems.

- U.S. Patent No. 9,740,662
- U.S. Patent No. 10,164,609B2
- U.S. Patent No. 10,169,293B2
- U.S. Patent No. 10,727,813B2
- Multiple International Patent Applications

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Licensing & Inquiries

Commercial use of our patented algorithms and methods is strictly prohibited without a licensing agreement.

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For Scientific Inquiries:
Dr. Jeffrey R. Smigelski, Ph.D.
Jeffrey.Smigelski@snoiselab.com

References:

1. Matusiak M. Optimization for Software Implementation of Fractional Calculus Numerical Methods in an Embedded System. Entropy (Basel). 2020 May 18;22(5):566. doi: 10.3390/e22050566. PMID: 33286338; PMCID: PMC7517086.
2. M. Matusiak, "An optimized MATLAB tool for efficient evaluation of fractional-order differential equations of time-varying orders," *2021 American Control Conference (ACC)*, New Orleans, LA, USA, 2021, pp. 1426-1431, doi: 10.23919/ACC50511.2021.9482974.