Flexionization Control System (FCS)

2025

FCS Pitch Deck

Next-Generation Nonlinear Control Architecture for UAVs and Robotics

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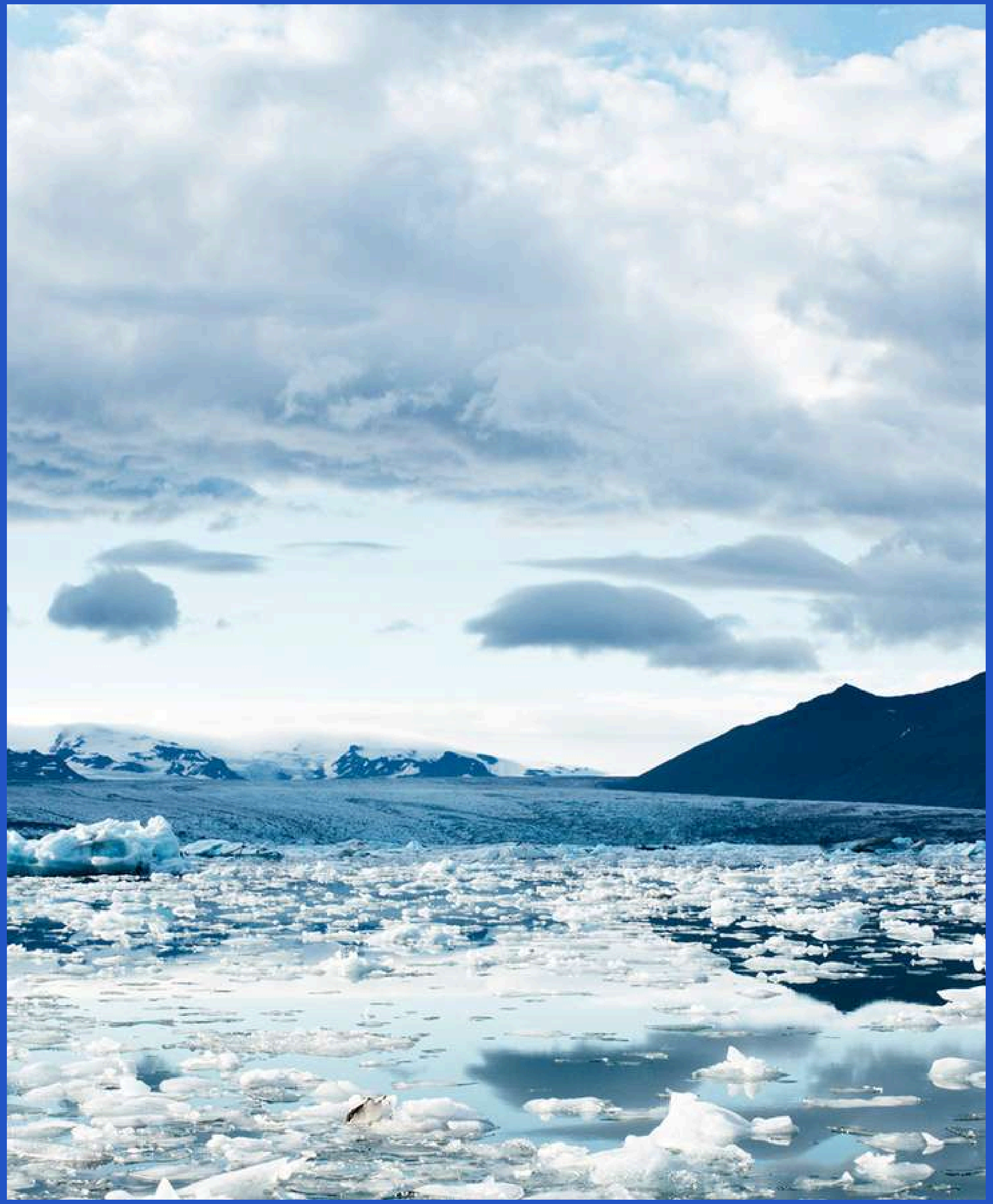
Problem

Modern UAVs, robots, and embedded systems operate in noisy, unstable, and nonlinear environments.
Traditional PID controllers fail due to:

- high noise sensitivity
- instability in nonlinear conditions
- constant retuning requirements
- slow disturbance rejection
- overshoot and oscillations under saturation

As robotics scales into critical applications, PID becomes a bottleneck for safety, performance, and reliability.



Solution

Flexionization Control System (FCS) replaces traditional PID with a nonlinear FXI–Δ–E architecture that provides stability, smoothness, and robustness in real-world conditions.

Core elements of FCS:

- F — nonlinear deviation transform
- E — equilibrium-based stabilization operator
- F^{-1} — inverse mapping for corrected output
- G — final actuator shaping

FCS eliminates oscillations, reduces noise sensitivity, and minimizes tuning requirements — enabling next-generation UAV and robotics performance.

How FCS Works

FCS processes the deviation through a sequence of nonlinear transformations:

$\Delta \to F \to E \to F^{-1} \to G \to u$

Where:

- Δ — raw deviation (error)
- F — transforms deviation into FXI-space
- E — stabilizes and smooths the signal
- F^{-1} — converts corrected FXI back to original domain
- G — generates actuator command

This architecture provides smooth, predictable, and robust control even in noisy, nonlinear, and fast-changing environments.

Nonlinear FXI–Δ–E Loop

Transforms deviation into FXI-space, applies stabilization, and converts corrected output back to control domain.

Real-Time Safe

Deterministic execution and no dynamic allocation. Designed for resource-limited microcontrollers.

Smooth & Stable Output

Architectural smoothing eliminates oscillations and noise sensitivity without heavy filtering.

Competitive Advantage

FCS introduces nonlinear FXI–Δ–E control architecture that solves the core limitations of PID and classical controllers.

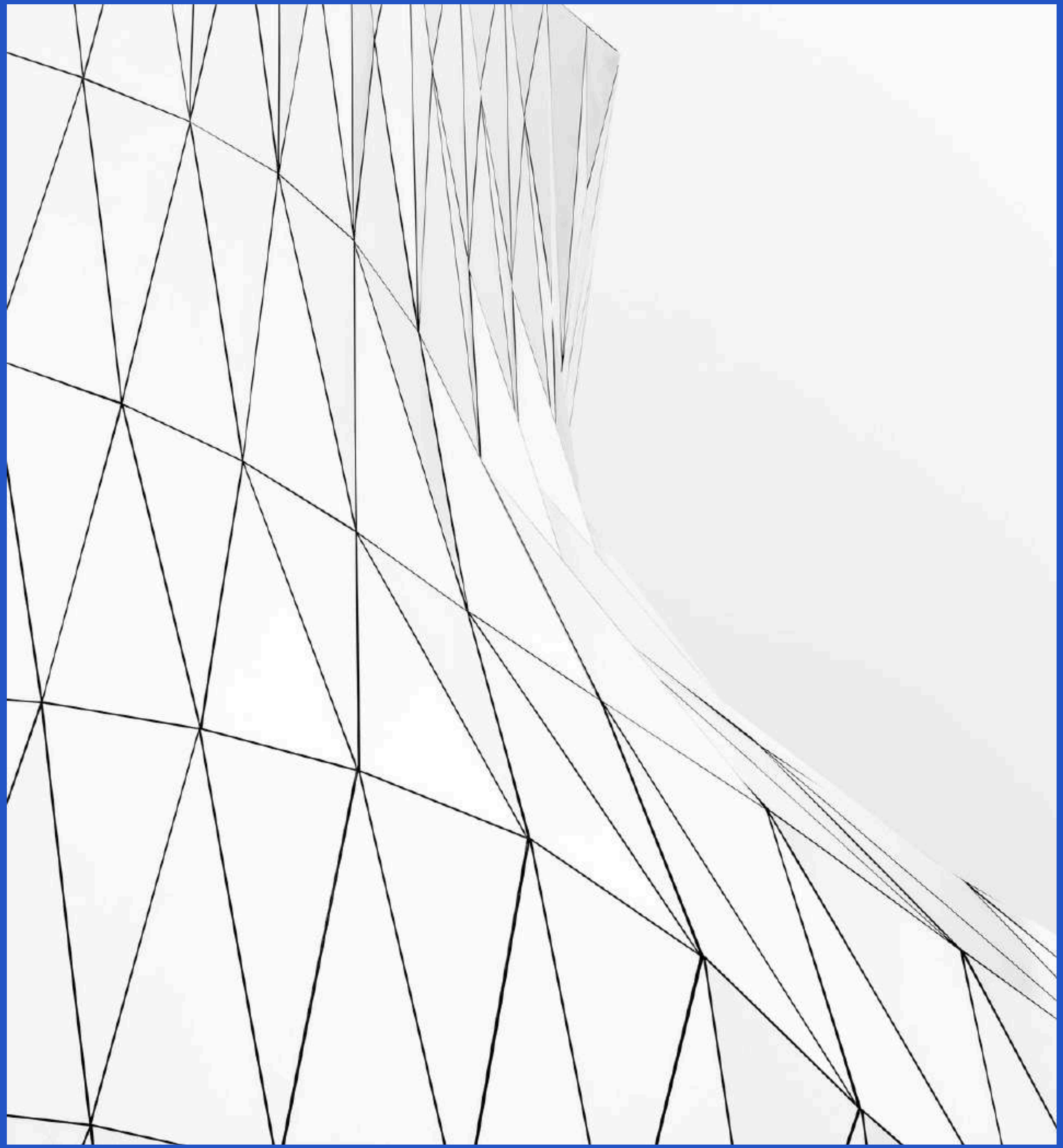
Key advantages:

- Noise Resistance
- Smoothing occurs at the architectural level — derivative noise is eliminated.
- Nonlinear Stability
- Predictable behavior in nonlinear conditions where PID becomes chaotic.
- Minimal Tuning
- Only a few parameters; stable across wide operating ranges.
- Fast Disturbance Rejection
- Quickly stabilizes after sudden external or mechanical changes.
- Saturation Handling
- Avoids overshoot, oscillations, and actuator saturation spikes.
- Smooth Control Output
- Clean, ripple-free response ideal for robotics and UAV flight control.

What We Have Built

FCS is not an idea — it is a functioning deep-tech control system with validated components.
We have built:

- Fully working C++ SDK
- Real-time safe, no dynamic allocation, modular F/E/F^{-1}/G operators.
- Mathematical foundation (V1.5)
- Full Flexionization theory, FXI–Δ–E structure, state-space, operators.
- Benchmark prototypes
- Nonlinear test loop, UAV axis stabilization demos, servo control.
- Documentation ecosystem
- One-Pager, Milestones roadmap, Technical Page.



Use Cases

FCS delivers high-stability control in systems where PID struggles most.
Key application domains:

UAV Flight Control

- Attitude stabilization
- Altitude hold
- Wind and vibration disturbance rejection
- Smooth control during aggressive maneuvers

Robotics

- Servo and actuator control
- Robotic arm joints
- Mobile robot motion
- Precise nonlinear movements

Industrial Automation

- Vibration damping
- Precision positioning
- Nonlinear actuator control
- Systems sensitive to noise and load shifts

Market Opportunity

The demand for advanced control systems is rapidly increasing as UAVs, robotics, and automation become mainstream across industrial sectors.

Total Addressable Market (TAM)

- $250B+ global robotics and UAV market
- Includes logistics, defense, inspection, agriculture, manufacturing, mobility

Serviceable Addressable Market (SAM)

$15B+ high-performance control and autonomy systems

Why Now?

- Rapid shift from mechanical to autonomous systems
- Increasing safety and precision requirements
- PID reaching practical performance limits
- Explosion of robotics startups lacking advanced control solutions

FCS positions itself as the next-generation control technology for this growing ecosystem.

Competitive Landscape

The control systems market is dominated by legacy architectures that struggle in nonlinear, real-world conditions.

PID Controllers (Industry Standard)

- Simple but outdated
- Unstable in nonlinear systems
- Highly sensitive to noise
- Require constant retuning

Model-Based Controllers (MPC, LQR)

- Powerful but computationally heavy
- Require complex models
- Not suitable for small MCUs and UAV processors

Proprietary Closed Control Loops

- Embedded inside drone/robot manufacturers
- Not accessible for developers
- Limited flexibility for custom hardware

Where FCS Stands

FCS fills the gap between simplicity and high-performance:

- More robust than PID
- Lighter and faster than MPC
- Fully modular and open for integration
- Real-time safe and microcontroller-friendly

FCS is the only system combining nonlinear stability + low compute + modular design.

Why We Win

FCS introduces a fundamentally new nonlinear FXI–Δ–E control architecture that solves limitations no competitor can address simultaneously.

Key winning advantages:

· Nonlinear Stability at Low Compute
FCS provides MPC-level smoothness and stability
while running on small microcontrollers (STM32, PX4, ESP32).

· Modular Architecture
Each operator (F, E, F^{-1}, G) can be customized
for different hardware, actuators, or dynamic models.

· Superior Noise Performance
Architectural smoothing eliminates disturbance spikes,
derivative noise, and jitter — without heavy filtering.

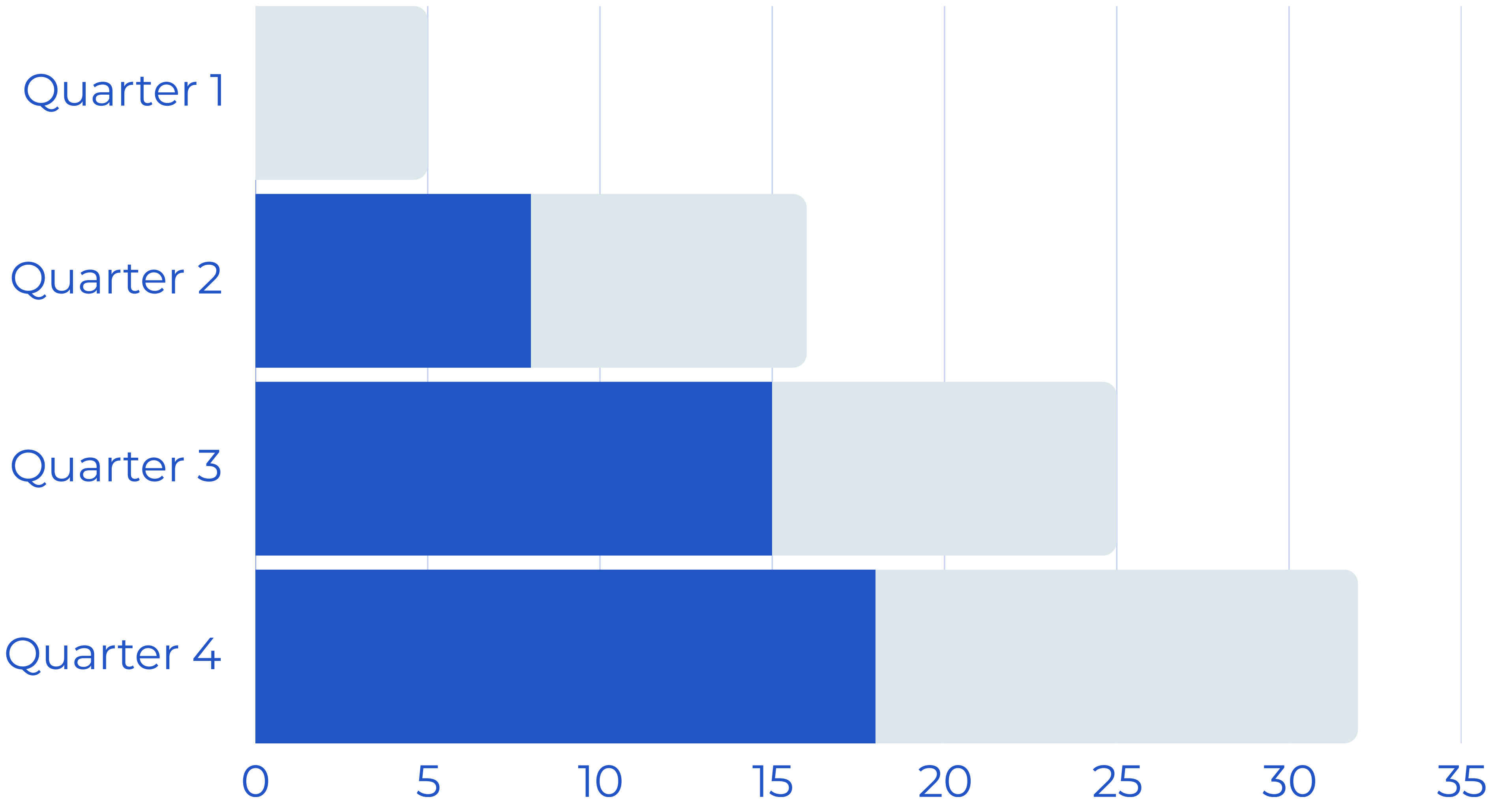
· Minimal Tuning
Only a few parameters required.
Stable across wide environments where PID fails or must be constantly retuned.

· Real-Time Safe
Deterministic execution, zero dynamic allocation,
fully embedded-friendly.

· Drop-In Upgrade Path
Easily integrates into existing PID loops
or replaces them entirely with minimal changes.

This combination makes FCS the most practical next-generation control system for UAVs, robotics, and industrial automation.

12-Month Roadmap



Core Foundation

- Finalize Whitepaper v1.0
- Stabilize SDK architecture
- Add servo, UAV axis, and robotic joint examples
- Release SDK v1.1

Integration & Validation

- PX4 / ArduPilot simulation integration
- Build physical hardware testbench
- (STM32 + IMU + servo rigs)
- Publish benchmarks vs PID
- Release SDK v1.2

Scaling & Productization

- Plug-and-play MCU control modules
- ROS2 integration package
- Automatic tuning tools
- Release SDK v1.3

Commercial Readiness

- FCS v1.0 stable release
- Safety layer + fallback modes
- First commercial pilot integration
- Licensing model (open core + enterprise)

Business Model

FCS follows a scalable hybrid model combining open-source adoption with commercial licensing.

Open-Source Core (Adoption & Ecosystem)

- Core FCS SDK available for developers
- Encourages integration into UAVs, robots, and embedded systems
- Drives community growth and real-world usage

Commercial Licensing (Enterprise Revenue)

- Advanced FCS modules (safety, multi-axis control, autotuning)
- Enterprise-level support and long-term maintenance
- Integration assistance for OEMs
- Per-device or per-project licensing options

OEM / Hardware Partnerships

- Direct integration with UAV manufacturers
- Robotics and industrial automation vendors
- White-label control modules for enterprise equipment

This model ensures wide adoption at the developer level while creating strong recurring revenue channels in enterprise and OEM markets.

Team

Founder
Maryan Bogdanov
Founder, Architect of FCS & Flexionization
Key Experience:

- Developer and creator of the FXI–Δ–E control architecture
- Author of Flexionization Mathematical Theory (V1.5)
- Designer of the FCS C++ SDK (real-time safe, modular, no dynamic allocation)
- Hands-on experience with UAV control, servos, IMU systems, embedded hardware
- Background in nonlinear systems, robotics, and control engineering

Maryan Bogdanov

Investment Ask

We are raising funding to bring FCS from a validated deep-tech prototype to a production-ready control platform.

Funding Requirements

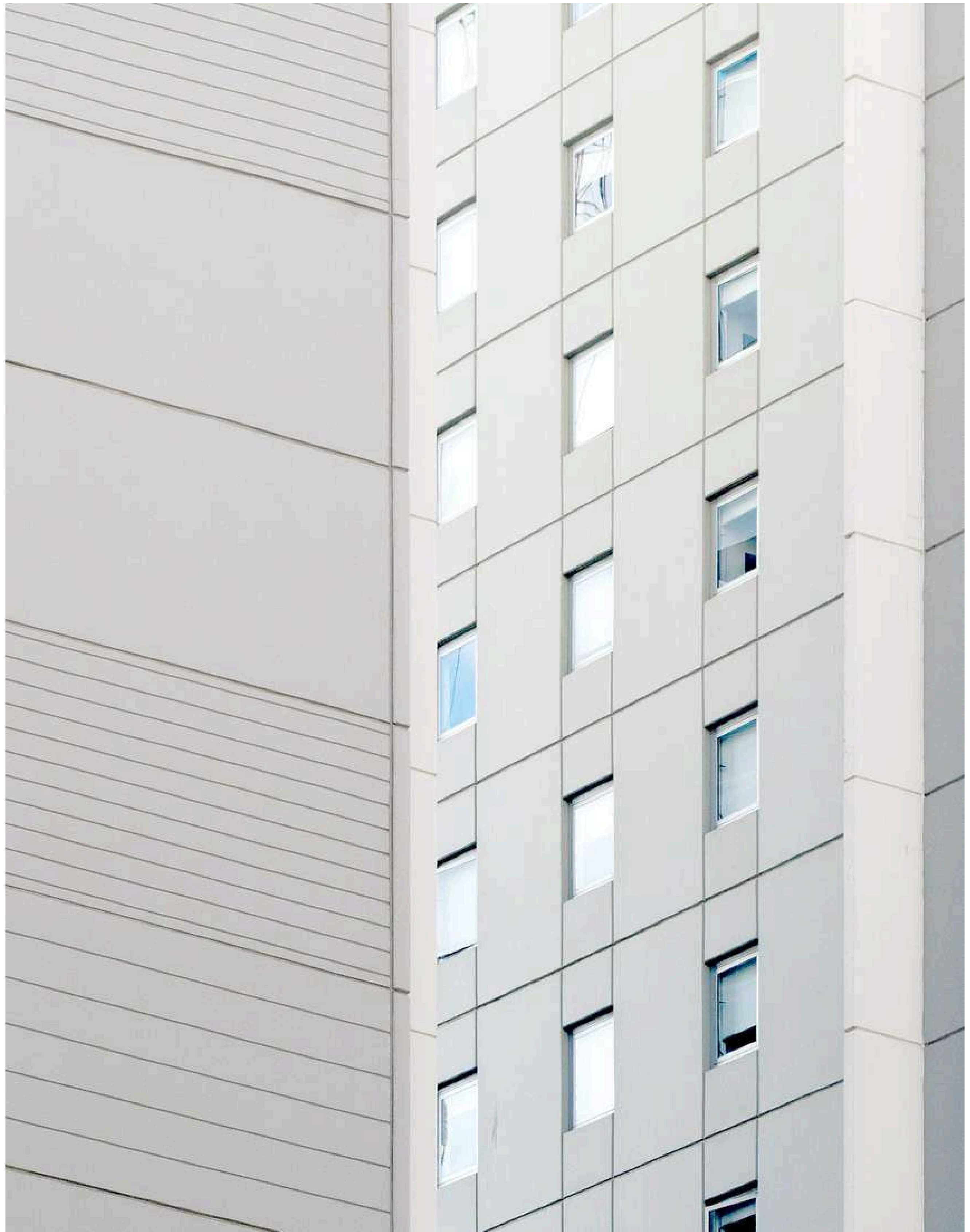
- Engineering team expansion
- Hardware testbench & robotics equipment
- Development of safety & multi-axis control modules
- PX4 / ArduPilot / ROS2 integrations
- Commercial pilot deployments

Use of Funds

- 40% — engineering & R&D
- 30% — robotics hardware, testing, validation
- 20% — documentation, developer ecosystem, community
- 10% — partnerships & integrations

What Investors Get

- A stake in a next-generation control technology
- Strong IP foundation (FXI–Δ–E architecture, Flexionization Theory V1.5)
- Rapidly expanding robotics & UAV market demand
- Early position in a system designed to replace PID



Thank You / Q&A

Flexionization Control System (FCS)
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For inquiries, partnerships, or technical discussion:

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