Noise-Stationary Interferometer Locking

A tabletop Mach-Zehnder experiment to test whether locking to a normalized noise slope-null can reduce jitter-induced measurement noise versus conventional power locking.

Immediate ask: $10K prototype/data sprint

Vnorm

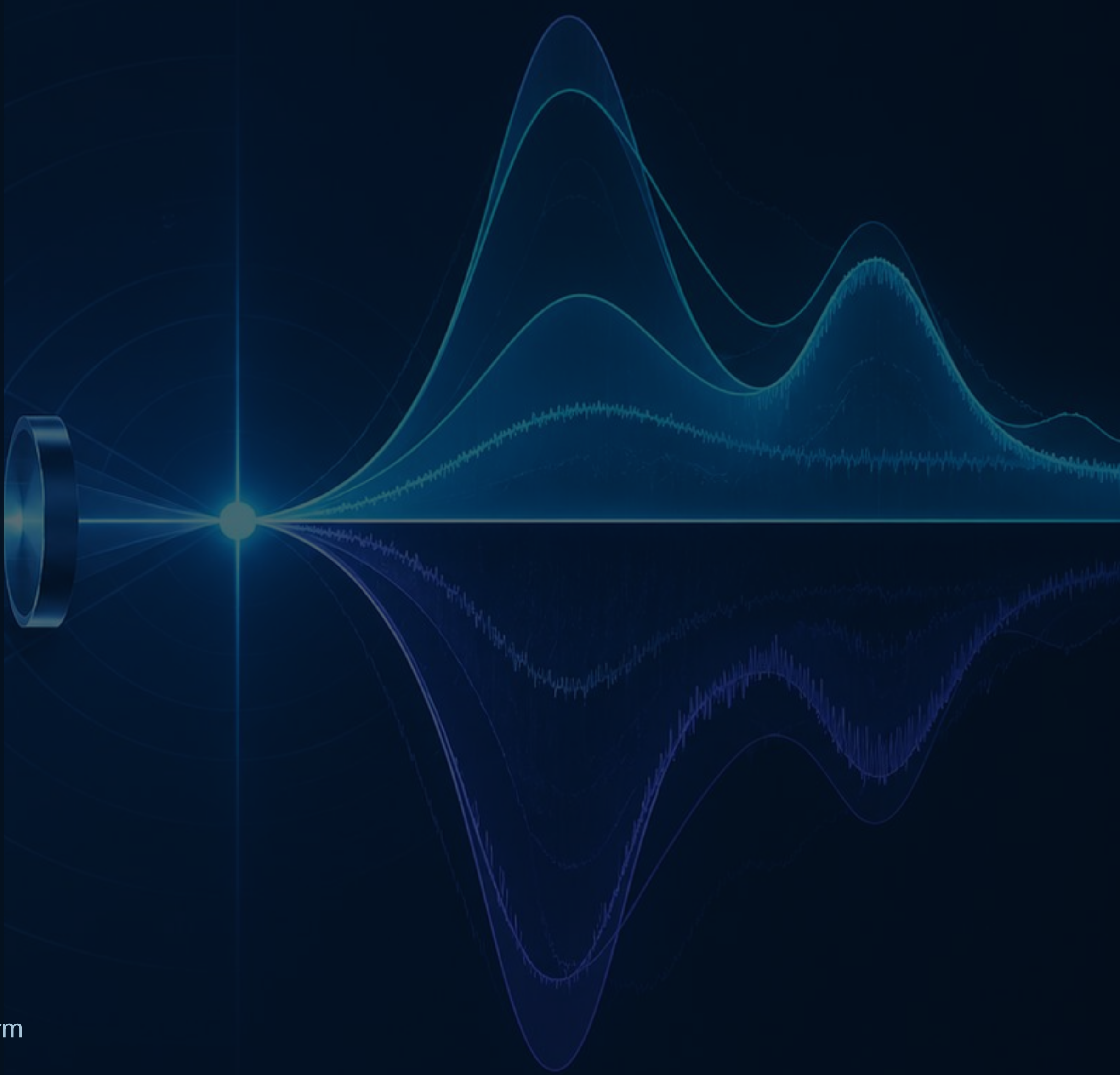
Nband / P^k objective

δ

slope-null operating point

MZI

first validation platform



Power locks protect the fringe — not necessarily the measurement noise.

Fieldable interferometric sensors face nonstationary disturbances: vibration, thermal drift, laser frequency noise, pointing jitter, speckle, platform motion, and mutual interference.

- Conventional locks stabilize optical power or a power-derived error signal.
- The power extremum can differ from the noise-optimal operating point.
- Detuning jitter can be converted into excess readout noise in the protected measurement band.

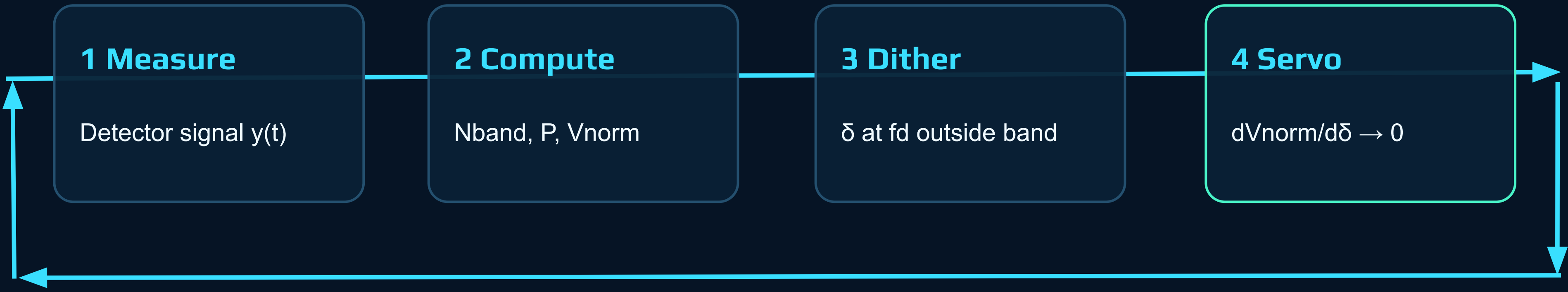
The gap: a robust control layer that optimizes measurement noise directly.

Source context: DARPA RoQS notes quantum sensors degrade in real-world settings due to vibrations, electromagnetic interference, and environmental disturbances.

SOLUTION

Lock at the Vnorm slope-null.

NSL turns the detector stream into a control objective tied to measurement noise, then servos the operating point to a slope-null condition.



The technical wedge is not “dither locking.” It is demodulating a normalized band-limited noise objective and driving its operating-point slope toward zero.

Core equation

$$Vnorm = Nband / P^k$$

$k \in [0,2]$
+ power-floor penalty
+ mislock recovery

Source context: PQSensing patent draft and fallback claims define Nband, P, Vnorm=Nband/P^k, dither/demod, power floor, and reacquisition logic.

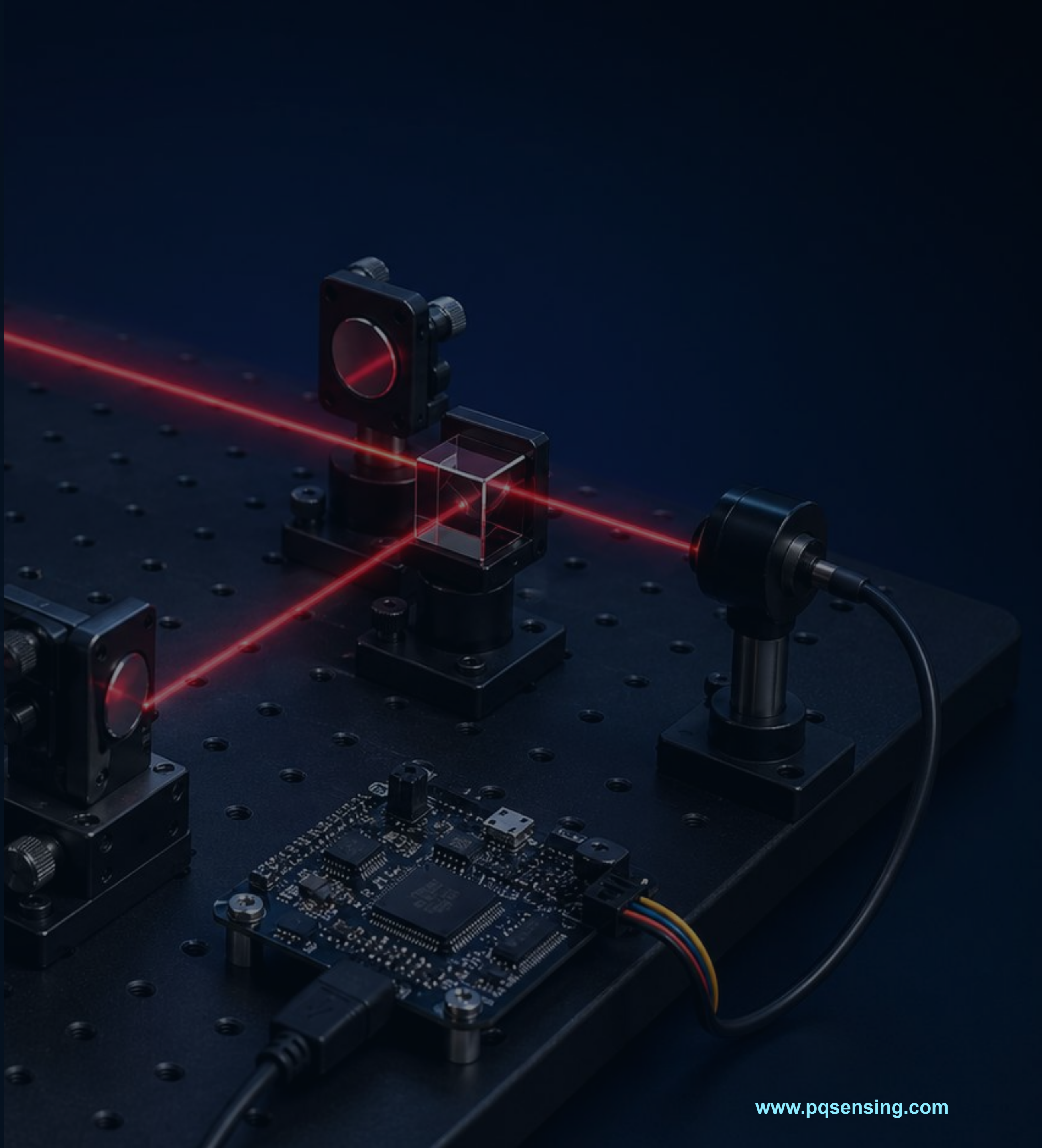
VALIDATION PLAN

Tabletop MZI proves or kills the thesis.

The first experiment is classical and intentionally small: produce defensible traces that compare power locking against NSL under controlled detuning jitter.

Sweep δ	Map P(δ), Nband(δ), Vnorm(δ).
Inject jitter	Apply repeatable detuning disturbance.
Engage NSL	Dither/demod Vnorm; servo slope-null.
Compare	Power lock vs NSL data package.

Success targets: ≥6 dB first-demo reduction; stretch 10–20 dB; ≥5 successful re-acquisitions.



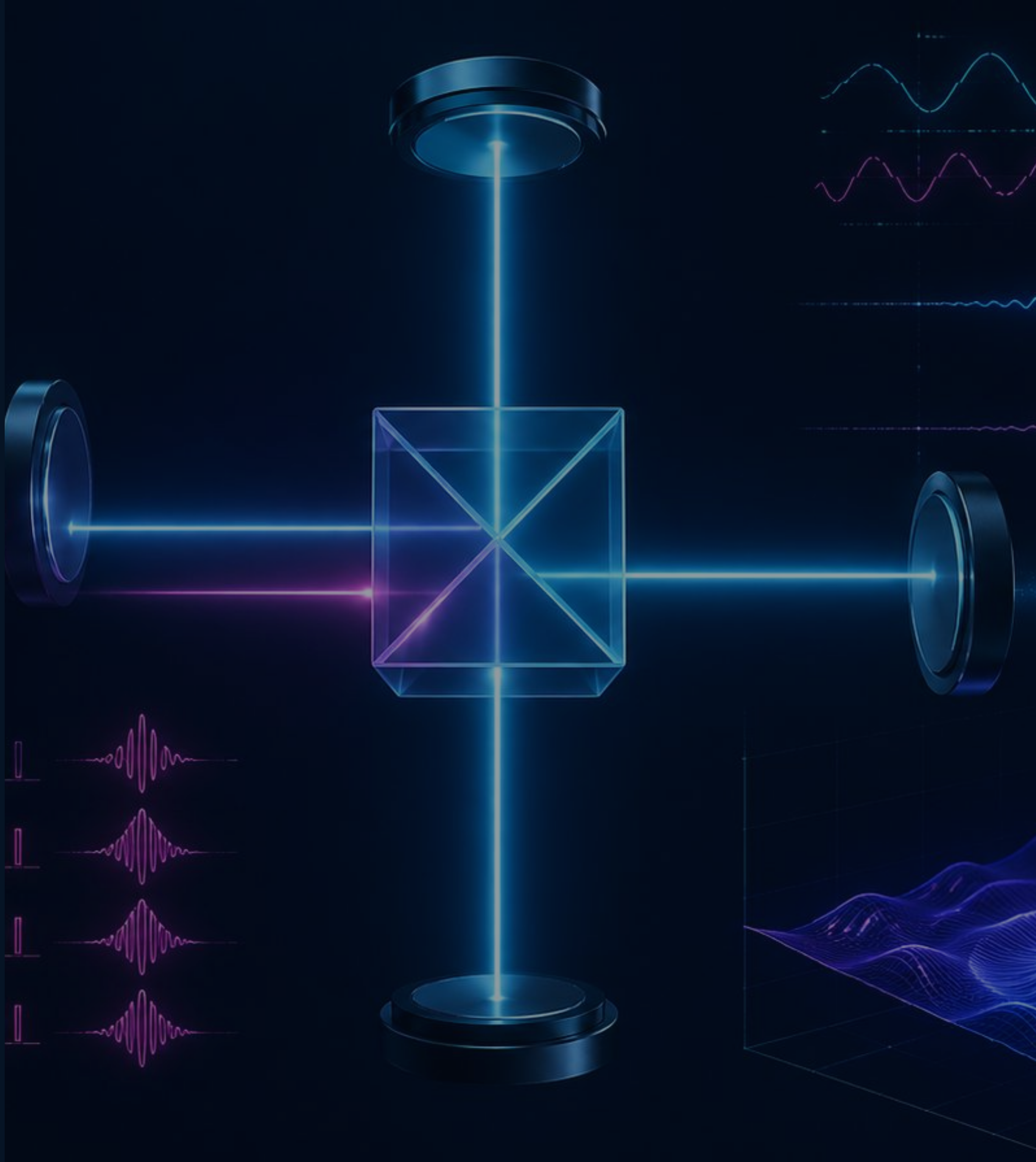
Intellectual Property

A field architecture with fallback claim depth.

The IP narrative is anchored to a specific control stack rather than a generic “better interferometer.”

01	**NSL control**	PSD/Welch or bandpass-square Nband, P metric, Vnorm=Nband/P^k.
02	**Control specificity**	Dither outside protected band, demodulate Vnorm, drive δ to slope-null.
03	**Robust operation**	Power-floor penalty and mislock-to-reacquisition state logic.
04	**Expansion layer**	Dark-port g(t) coding, homodyne recovery, squeezed-state variants, PIC/SU(1,1).

Licensing wedge: a control method / firmware layer for interferometric sensor OEMs.



Source context: PQSensing nonprovisional draft and fallback claim package. Not legal advice.

MARKET

Robust sensing is the transition bottleneck.

The first market is not a finished quantum sensor. It is a robust control layer that can improve interferometric readout in systems where field disturbances erase lab-grade sensitivity.

$7–10B
quantum sensing by 2035
(McKinsey scenario)

$1.3–1.5B
quantum sensor market by 2034
(market-research estimates)

Defense PNT / ISR	GPS-denied sensing, inertial/gravimetry, platform vibration.
Metrology OEMs	Cavities, MZI, Michelson, mode cleaners, precision phase sensing.
LiDAR / FSOC	Dark-port coding, interference rejection, correlation signatures.

Sources: DARPA RoQS; McKinsey Quantum Technology Monitor 2025; Precedence Research and Fortune Business Insights quantum sensor market pages.

Solo inventor. Lean execution. Partner-ready.

Jon Michael Peterson

Precision technical professional and solo inventor with 20+ years of hands-on engineering support, drafting, and systems problem-solving experience.

- Practical hardware discipline: prove the core effect before scaling.
- Open-source DSP / reproducible data package for credibility.
- University lab path for OPO/squeezed-light integration after classical validation.
- SBIR/STTR and licensing path for non-dilutive or strategic capital.

1. **MZI data sprint**
   Classical tabletop proof
2. **SBIR / partner demo**
   All-fiber + dark-port code
3. **Quantum integration**
   Squeezed-state / homodyne path
4. **Licensing**
   OEM / defense / photonics

Source context: founder profile from PQSensing master invention file.

First data package: $10K.

Minimum useful prototype budget: build the tabletop MZI, implement NSL, inject jitter, and package the data for investors, companies, and non-dilutive funding.

Budget allocation

Optics + mechanics	$3.0K
Laser/readout/DAQ path	$2.5K
Actuator + driver + control	$2.0K
DSP, safety, misc.	$1.5K
Shipping/contingency	$1.0K

Milestones

- **0–2 wks** assemble MZI + baseline fringe
- **2–4 wks** sweep δ; choose Vnorm band/k
- **4–6 wks** closed-loop NSL + jitter tests
- **6–8 wks** raw data, plots, outreach package

Outcome: first credible NSL data package for licensing/SBIR/investor conversations.

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