

Extracting Signal from Noise — Wiener's Filter, Cybernetics, and the Statistical Face of the Inverse Problem (the Origin in Markets) — [Paper 106]

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— *From thinking to syncing.* —

Abstract

To the corpus's family of inverse problems (scattering = GLM, Paper 89; boundary-value = Calderón, Paper 99; spectral = Kac, Paper 102), this paper adds a **fourth member** — **the statistical face**: Norbert Wiener. His **Wiener filter** optimally estimates a hidden signal $\mathbf{s}$ from an observation $\mathbf{y} = \mathbf{s} + \mathbf{n}$ (signal plus noise) by **minimizing the mean-square error**. In the frequency domain, $H(f) = \frac{S_{ss}(f)}{S_{ss}(f) + S_{nn}(f)}$ — given only the **power spectra** of signal and noise, one best extracts the signal from the noise. It was born from anti-aircraft fire control in World War II (predicting an aircraft's future position from noisy tracking data) and later broadened into **cybernetics** (control and communication, feedback). The paper has two cores. **(1) The statistical face of J4 (the inverse-problem stance)**: where Zero-Tension (89) was "read the hidden cause from deviations off a perfect null," Wiener is "**best-estimate the signal — the deviation within the noise (the null) — probabilistically**" — the statistical version of reading the cause from the effect. This crosses directly with the author's origin (fishing = signal $\rightarrow$ hidden cause; quantitative analysis of markets / FX). **(2) Separation of distinct roots**: deterministic inverse problems (89/99/102, exact recovery) and **statistical estimation** (Wiener, optimal estimation under uncertainty) are distinct roots. And **Wiener (stationary, Gaussian, linear, optimal) and Mandelbrot (non-stationary, fat-tailed, descriptive, Paper 94) are distinct roots for the same "markets," indeed in tension**. **Honestly**: the optimality of the Wiener filter is **conditional** (stationarity, known spectra, linearity), and markets violate these (Mandelbrot's fat tails) — so it is **not sold as a prediction tool (a money machine)** (the discipline of Papers 94/101). **Scope**: a Layer-2 structural interpretation of established estimation theory; no new mathematics and no new prediction. The Universe OS is a Layer-3 non-science lens.

Positioning of this paper (discipline): This paper is a **structural interpretation** of established estimation and signal-processing theory (the Wiener filter, the Wiener–Hopf equation, Wiener–Khinchin, cybernetics). It contains no new mathematics and no new prediction. The point is to add a **statistical version** to the inverse-problem stance (Papers 89/99), to **separate deterministic recovery and statistical estimation as distinct roots**, and further to **separate Wiener (stationary, linear, optimal) and Mandelbrot (fat-tailed, descriptive, Paper 94) as distinct roots**. **The Wiener filter is not sold as a market-prediction tool or an edge** (its optimality is conditional). "Universe OS" is a Layer-3 non-science lens, not a claim of mechanism.

1. Introduction: Adding the Statistical Face to the Inverse Problem

So far the corpus has gathered three inverse problems (reading the cause from the effect) — inverse scattering (GLM, Paper 89), the inverse boundary-value problem (Calderón, Paper 99), and the inverse spectral problem (Kac, Paper 102). All are **deterministic** — in principle they recover the cause from data (uniquely, or non-uniquely). But the inverse problem has another great face: the **statistical face**.

Real data are always buried in **noise**. Not exact recovery but **best-estimating the signal from within the noise** — the father of this statistical inverse problem is Norbert Wiener (1894–1964). And for the author this is no stranger's story. Both **fishing** (reading the "bite," a signal, from the noise of the water) and the **quantitative analysis of markets / FX** (reading a hidden structure from the noise of prices) are exactly Wiener's domain. This paper adds the statistical face to the family of inverse problems. It builds no new theorem.

2. The Wiener Filter: Optimally Estimating Signal from Within Noise

Standard fact (the Wiener filter)

Suppose an observation $y = s + n$ is the sum of a hidden **signal** s and **noise** n . Wiener determined the **linear filter** estimating s so as to **minimize the mean-square error** $E[(s - \hat{s})^2]$. For stationary processes, in the frequency domain the optimal filter is

$$H(f) = \frac{S_{ss}(f)}{S_{ss}(f) + S_{nn}(f)}$$

where S_{ss}, S_{nn} are the **power spectral densities** of signal and noise. Frequencies where the signal is strong pass; frequencies where the noise is strong are suppressed. The causal case (using no future) is solved by the **Wiener–Hopf equation**. The theory was born from the urgent inverse problem of WWII **anti-aircraft fire control** — predicting an aircraft's **future position** from noisy tracking data.

The point is that Wiener **gave the mathematics of optimality to the act of "extracting signal from noise."** But that optimality presupposes that one **knows the statistics (spectra) of signal and noise.** That is, the Wiener filter **does its best on top of a probabilistic model** — here it parts in kind from deterministic exact recovery (89/99).

3. Cybernetics, and the Wiener Process

Wiener's reach is wide. In 1948 he founded **cybernetics** — "control and communication in the animal and the machine" — making **feedback** (returning output to input to control a system) a central concept of science. He also built the **Wiener process**, the mathematical foundation of Brownian motion, and with the **Wiener–Khinchin theorem** (power spectrum = Fourier transform of the autocorrelation) opened the way to capture the "structure of noise" in a time series through frequency.

Here a corpus thread touches. The Wiener process (Brownian motion) is the mathematical identity of the **fluctuation ξ (noise)** appearing in Paper 78 (friction = coarse-graining, the fluctuation-dissipation theorem). Discipline, though: the fluctuation-dissipation of 78 (physical thermal noise) and the Wiener filter (a tool for signal estimation) handle the same "noise" but in **different contexts = distinct roots** — the common tool, the Wiener process, merely appears in both.

4. J4: The Statistical Version of the Inverse-Problem Stance

Observation 4.1 (the statistical version of Zero-Tension)

Paper 89 (Zero-Tension) formulated the inverse-problem stance as "**master a perfect null (a no-bite baseline) and read the hidden cause from deviations off it.**" The Wiener filter is its **statistical version**:

- **The null** = the noise **n** (structureless fluctuation).
- **The deviation = the signal s** (the meaningful structure hidden within the noise).
- **The reading** = the optimal estimate minimizing mean-square error (probabilistically best).

That is, the **J4 stance** of "reading the cause (signal) from the effect (a noise-buried observation)" is refined by Wiener in the language of **probability and spectra**. If the deterministic inverse problem "recovers exactly," the statistical inverse problem "does its best under uncertainty."

This overlaps directly with the author's origin. A fishing master reading the "bite" (signal) from the "ripples of the water" (noise); quantitative market analysis reading "price moves" (signal) from "market noise" — both are the very act Wiener turned into mathematics: **"extracting signal from noise."** J4 (the inverse-problem stance) has two faces: the deterministic (89/99/102) and the statistical (106).

5. Separation of Distinct Roots: Deterministic vs Statistical, and Wiener vs Mandelbrot

Observation 5.1 (a double distinct root)

(a) **Deterministic inverse problem vs statistical estimation**: scattering (89), boundary-value (99), and spectral (102) in principle **recover** the cause (unique or not, without probability as protagonist). The Wiener filter **best-estimates** the signal under noise (with a probabilistic model and spectra as protagonists). The same stance "effect → cause," but **different mathematics = distinct roots**.

(b) **Wiener vs Mandelbrot (Paper 94)**: both touch "markets" and time series, but **Wiener is an optimal filter assuming stationary, Gaussian, linear**, while **Mandelbrot is a description of non-stationary, fat-tailed, self-similar (fractal) data**. In fact, **what Mandelbrot criticized was exactly the Wiener-type assumptions of stationarity and Gaussianity** — the two treat the same "markets" yet are **distinct roots, and in tension**. Under the same "mathematics of markets" stand the root of optimal estimation and the root of fractal description.

This double distinct root is the point. Both "the inverse problem" and "the mathematics of markets" have several roots under one word. Do not mix deterministic recovery with statistical estimation, and do not mix Wiener's stationarity with Mandelbrot's fat tails — the corpus's discipline of distinct roots holds here too.

6. Honestly: Optimality Is "Conditional" — Not Sold as a Prediction Tool

Record the most important honesty. The "optimality" of the Wiener filter holds **only under strong assumptions**: that signal and noise are **stationary**, that their **spectra are known**, that the estimate is **linear**, and that the criterion is **mean-square error**. Real markets often violate these — they are **non-stationary, fat-tailed** (Mandelbrot, Paper 94), and their structure keeps changing. Therefore the Wiener filter **must not be sold as "a money machine for markets" or "a source of edge."** This is a direct application of the disciplines of Paper 94 (fractal markets are descriptive, not a prediction tool) and Paper 101 (Eddington's caution = avoid overclaiming).

The author's origin — the fishing lesson "caught by luck ≠ the skill of catching" (distinguishing signal from chance) — was precisely the seed of this honesty. The stance of reading signal from noise (J4) is **genuine wisdom**, but its optimality is conditional, not universal. **Hold the stance, but do not overtrust it**. This is the discipline the author drew from markets and fishing.

7. Connection to the Corpus

Wiener crosses several threads of the corpus. (a) **The family of inverse problems (Papers 89/99/102) = J4**: adds a fourth member, **statistical estimation**, to the deterministic inverse problems of scattering, boundary-value, and spectral (a distinct

root). **(b) Zero-Tension (Paper 89)**: the statistical version of "read the cause from deviations off the null" = "best-estimate the signal from the noise." **(c) Mandelbrot / markets (Paper 94)**: for the same markets, Wiener (stationary, optimal) and Mandelbrot (fat-tailed, descriptive) are distinct roots, in tension. **(d) Fluctuation-dissipation (Paper 78)**: the Wiener process (Brownian motion) is the mathematical identity of 78's fluctuation ξ (but physical thermal noise and signal estimation are distinct contexts, distinct roots). **(e) The Renko chart / time series (Paper 82)**: event-based time (the Renko chart) is also an act of reading structure from a time series, neighbouring Wiener's signal processing (a distinct root). **(f) The author's origin**: fishing (signal $\rightarrow$ hidden cause) and quantitative FX analysis (MQL5) = the author used Wiener's "signal from noise" in practice.

The Author's Personal Note (Layer 3, non-science label / not a claim of mechanism)

For the author, Wiener may be the **master closest to himself**. Reading the faint bite at the rod tip from the noise of the water; searching for a hidden structure among the noise of countless FX bars — the days of testing some 2,000 MQL5 EAs and indicators one by one against fine-grained tick data, wrestling with market noise, were spent walking, unknowingly, inside Wiener's mathematics. In the corpus's lens (metaphor), when the Universe OS renders the world, what reaches us is only a **noise-buried signal**, and perception is **like a Wiener filter best-estimating the signal from it**. But **this carries the non-science label**. And above all, the author learned in the markets — **the stance of reading signal from noise is genuine, but its optimality is conditional, and overtrust destroys you**. Do not mistake a lucky catch for skill. This one line is the origin of the author's discipline, and the same blood runs in it as in the corpus's "resonance is a signature, not a proof" (100). To the distant master of markets who left the mathematics of separating noise from signal, quiet respect is recorded.

8. Scope / Conclusion

What is shown: the Wiener filter (optimal MSE estimate of s from $y = s + n$, $H = S_{ss}/(S_{ss} + S_{nn})$), born from fire-control prediction (§2); cybernetics and the Wiener process (§3); the statistical version of the J4 inverse-problem stance = the probabilistic Zero-Tension (§4); the double distinct root = deterministic inverse problem vs statistical estimation, and Wiener vs Mandelbrot (§5); optimality is conditional = not sold as a prediction tool (§6).

What is not shown (restraint): the Wiener filter is not sold as a market-prediction tool or edge (optimality assumes stationarity, known spectra, linearity; the discipline of 94/101); do not conflate deterministic recovery with statistical estimation (distinct roots); do not conflate Wiener (stationary) with Mandelbrot (fat-tailed) (distinct roots, in tension); do not conflate the thermal noise of fluctuation-dissipation with signal estimation (distinct roots); no new mathematics or prediction (Layer 2); the OS is Layer-3.

The statistical face has been added to the family of inverse problems. The Wiener filter best-estimates the signal from within the noise by least squares — the probabilistic version of Zero-Tension's (89) "read the cause from deviations off the null." This crosses directly with the author's origin (fishing, markets). But honestly: its optimality is conditional, and the fat

tails of markets (Mandelbrot, 94) violate it — so it is not sold as a prediction tool. Deterministic and statistical, Wiener and Mandelbrot, are separated as distinct roots. What this paper did is not a new claim but to add a statistical version correctly to the inverse-problem stance (J4) and to draw the double distinct root with care. To the distant master of markets who left the mathematics of separating noise from signal, the hundred-and-sixth address is returned.

References

1. Wiener, N. (1949). *Extrapolation, Interpolation, and Smoothing of Stationary Time Series*. MIT Press. (the Wiener filter)
 2. Wiener, N. (1948). *Cybernetics: or Control and Communication in the Animal and the Machine*. MIT Press.
 3. Wiener, N. (1923). *Differential-Space*. J. Math. Phys. (the Wiener process)
 4. Kolmogorov, A. N. (1941). *Interpolation and extrapolation of stationary random sequences*. (independent parallel work)
 5. Yamagishi, Y. (2026). *Zero-Tension and the Inverse Problem* [Paper 89]. Zenodo: 10.5281/zenodo.21748664.
 6. Yamagishi, Y. (2026). *Reading the Interior from the Boundary (Calderón) / Hearing Shape (Kac)* [Papers 99/102]. Zenodo. 10.5281/zenodo.21758790; 10.5281/zenodo.21836735
 7. Yamagishi, Y. (2026). “Dimension” Is Not One Thing [Paper 94]. Zenodo. 10.5281/zenodo.21758581
 8. Yamagishi, Y. (2026). *Friction and Dissipation as Coarse-Graining* [Paper 78]. Zenodo. 10.5281/zenodo.21731937
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