THOR FUNDS

THOR FINANCIAL TECHNOLOGIES

Signal Processing 101

A Systematic Approach to Regime-Based Portfolio Management

INSTITUTIONAL WHITE PAPER

THOR Funds

THOR Financial Technologies

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Contents

INTRODUCTION

A Systematic Approach

THOR Funds does not manage money with predictions. Not with committee consensus. Not by reacting to whatever narrative dominates the financial media on a given day.

THOR manages money with a system — one built on the science of signal processing, engineered to detect market regime changes and act on them without human emotion.

This white paper explains exactly what that means: how signal processing applies to financial markets, why it works, and why most investment processes — even institutional ones — remain fundamentally compromised by behavioral bias.

This is not a pitch for a magic formula. It is an explanation of why the conventional approach to portfolio management is structurally flawed, and how engineering principles — the same ones inside noise-canceling headphones — offer a disciplined alternative.

CHAPTER ONE

The Behavioral Problem

Most investors — retail and professional — underperform. Not because they lack intelligence or resources. Because they are human.

The Emotion Problem

Behavioral finance has spent decades documenting the ways human psychology sabotages investment returns:

- **Loss aversion:** Investors feel losses roughly twice as intensely as equivalent gains. A $10,000 loss hurts more than a $10,000 gain feels good. This asymmetry drives premature selling during rallies and paralysis during declines.
- **Recency bias:** Recent events are overweighted. A 3% weekly decline feels like a crisis. A 3% rally signals all-clear. Neither reaction is grounded in structural evidence.
- **Herd mentality:** Capital flows in at tops and out at bottoms — consistently, across decades, across investor types.
- **Narrative fallacy:** Every price movement gets a story. "Markets fell on trade war fears." Perhaps. Or perhaps a journalist needed a headline to explain random noise.

The result is well-documented. Dalbar's annual Quantitative Analysis of Investor Behavior consistently shows average investors earn roughly half the market's actual return over long periods. Not because of poor security selection — because of poor *timing* decisions driven by emotion.

The Asymmetry of Losses

One number changed the entire trajectory of THOR's investment philosophy:

40% → 67%

A 40% loss requires a 67% gain just to break even

If a portfolio drops from $1,000,000 to $600,000, it must earn 67% on that reduced base — not 40% — to recover. The asymmetry compounds:

LOSS	GAIN REQUIRED TO RECOVER
-10%	+11.1%
-20%	+25.0%
-30%	+42.9%
-40%	+66.7%
-50%	+100.0%

This is why drawdown management is not a feature — it is the foundation. Over 85 years of market data, avoiding just the 10 worst days would have grown $1 invested in the S&P 500 to $256, versus $81 for buy-and-hold. The asymmetry of losses is the single most important concept in portfolio management, and remarkably few investment processes are built around it.

The Buy-and-Hold Limitation

Buy-and-hold works over multi-decade horizons — with perfect discipline and the assumption no investor will capitulate at the bottom. In theory.

In practice, 25-year rolling returns for the S&P 500 vary dramatically. 10-year real returns have ranged from +16% annualized to negative 3%. Retirement timing alone can determine financial outcomes more than decades of saving.

The question is not whether markets appreciate over time. They do. The question is whether investors can survive the drawdowns along the way — financially and psychologically. The data says most cannot.

THOR was built to address this problem directly.

CHAPTER TWO

What Is Signal Processing?

Consider what happens inside a pair of noise-canceling headphones.

Tiny microphones constantly sample ambient noise — the drone of a jet engine, the hum of an office, the rumble of a subway car. Digital signal processing analyzes the waveform of that noise in real-time, generates an inverse waveform — an equal and opposite signal — and plays it back. The noise is cancelled. Only the music remains.

> **THOR's system applies this same discipline to price data.**

From Audio Engineering to Markets

Every asset, when charted over time, is a waveform. It has amplitude (how far prices move), frequency (how often they oscillate), and noise (random fluctuations that obscure the underlying pattern).

Raw price data is extraordinarily noisy. On any given day, prices move for thousands of reasons — earnings reports, central bank commentary, options expiration flows, algorithmic rebalancing, execution errors. Most of these movements are meaningless. They are noise.

But beneath that noise is a signal — the actual trend, the real direction, the structural character of the market at that moment. Isolating that signal is the core challenge.

Traditional investment processes attempt to solve this by interpreting the noise — constructing narratives around daily movements. "Markets fell because of China trade fears." "Tech rallied on AI optimism." These are stories layered on top of randomness. They feel explanatory but have zero predictive value.

Signal processing solves it differently. Instead of interpreting noise, the system *removes* it.

The Core Insight

CORE INSIGHT

Constant, steady noise is easy to filter. It is the sudden, random disruptions that are difficult.

The noise-canceling analogy holds precisely. Headphones excel at blocking the steady hum of a jet engine — consistent, low-frequency noise. They are less effective against a sudden, sharp clap — an unpredictable burst.

Markets behave identically. Steady, low-frequency trends are identifiable and investable. Random daily noise is not. The key is converting chaotic, high-frequency price data into a lower-frequency waveform where the real trend becomes visible.

That conversion — from high-frequency noise to low-frequency signal — is what THOR's system performs. Internally, it is called **The Signal.**

CHAPTER THREE

How The Signal Works

The following describes the conceptual framework — the philosophy rather than proprietary implementation details — because the philosophy is what differentiates the approach.

STEP I

Convert Noisy Data to a Smooth Waveform

Raw price data is chaos — red noise, random, and impossible to act on directly. The first transformation converts that raw data into a clean waveform.

The system uses momentum-based transformations to capture underlying price strength while smoothing day-to-day randomness. Think of it as converting a scratchy AM radio signal into clean digital audio. The information is the same — the static has been removed.

STEP II

Apply Digital Signal Processing Filters

Once the waveform is smoothed, the system applies signal processing filters adapted from electrical engineering and physics. These are not conventional moving averages.

Traditional moving averages treat all data points equally — last Tuesday's close carries the same weight as today's in a 50-day average. That is the equivalent of designing noise-canceling headphones that treat all frequencies identically. It does not work. Different frequencies require different treatment.

THOR's filters are designed to isolate specific waveform components — separating cyclical structure (the music) from low-frequency drift and high-frequency noise (the static). The result is a clean, oscillating signal that rises and falls through definable turning points.

STEP III

Detect Regime Changes

This is the critical step. The filtered signal does not merely indicate whether the market is up or down today. It identifies when the *character* of the market is changing.

The system looks for structural turns — moments when the signal confirms a genuine inflection point. Not a blip. Not a one-day reversal. A confirmed change in regime from risk-on to risk-off, or vice versa.

Confirmation is required before the system acts. It does not respond to every fluctuation. It waits for evidence that a real turning point has formed — a validated trough or a confirmed peak. Only then does positioning change.

STEP IV

Act

When a regime change is confirmed, positioning changes. The process is mechanical.

— **Risk-on:** The Signal shows a confirmed uptrend. Capital is deployed.

— **Risk-off:** The Signal shows a confirmed downturn. Capital is moved to safety.

The discipline is in the design. There is no debate. No committee meeting. No "the fundamentals look acceptable but the technicals are concerning." The Signal either confirms risk-on or risk-off. The system follows it.

What Makes This Different

The system uses science, not math.

Math is linear. Markets are not.

Moving averages, RSI, MACD — these are mathematical tools designed for linear systems. Markets are nonlinear, cyclical, and chaotic. They require tools borrowed from physics and engineering — the same tools used to process audio signals, radar data, and telecommunications.

THOR's system does not lay rulers on charts. It decomposes waveforms.

CHAPTER FOUR

Regime Changes Explained

A regime change occurs when the fundamental character of the market shifts. Not a pullback. Not a bad day. A genuine change in the underlying trend.

The analogy is seasonal. Summer does not become winter because of one cold day in August. But when September comes and the days keep shortening and temperatures keep dropping, at some point the season has changed. That is a regime change.

Why Regime Changes Matter

Most investment losses occur during regime changes that investors fail to recognize — or recognize too late.

Consider the anatomy of a typical bear market:

1. **The signal shifts.** Something changes in the underlying structure. Most market participants do not notice because headlines remain positive.
2. **Early decline.** The market drops 5–8%. Commentators call it a "healthy pullback." Investors buy the dip.
3. **Acceleration.** The decline deepens to 15–20%. Narratives shift to concern. Investors who bought the dip are underwater.
4. **Capitulation.** The market falls 30–40%+. Selling intensifies at the bottom.
5. **Recovery begins.** The signal shifts again. But investors, now traumatized, remain in cash while the market rallies 20–30% without them.

This pattern repeats with striking consistency because it is driven by human psychology, not market mechanics. The Signal is designed to detect phase 1 — the structural shift — and reposition before the crowd recognizes what is happening.

Historical Context

2008 Financial Crisis: The S&P 500 fell 57% from peak to trough. The structural character of the market had changed months before Lehman Brothers collapsed in September 2008. A signal processing approach detecting the regime change early — even imperfectly — would have avoided the bulk of the devastation. The math: a 57%

loss requires a 133% gain to recover. The S&P did not reclaim its pre-crisis high until 2013 — five years later.

March 2020 (COVID): The market fell 34% in 23 trading days — the fastest bear market in history. This was an extreme, sudden disruption — more like a clap than a steady hum. Even here, structural deterioration was detectable in the signal before the worst of the selling. Equally important, the signal's detection of the *recovery* — the regime change back to risk-on — was critical. Many investors remained in cash well into 2021, missing a historic rally.

2022 Bear Market: The S&P fell 25% over nine months as the Federal Reserve aggressively raised rates. This was a cleaner, more sustained regime change — precisely the environment where signal processing excels. The steady, grinding nature of the decline was highly filterable. The subsequent recovery was similarly detectable.

In each case, the question is not whether the exact top or bottom could have been timed. It could not. The question is whether the regime change could have been detected early enough to avoid the worst of the drawdown and re-enter near the start of the recovery. That is the objective. That is what The Signal was built to accomplish.

CHAPTER FIVE

The Signal vs. The Noise

An hour of financial media produces approximately 47 reasons why the market will rise and 47 reasons why it will fall. Every one sounds plausible. None are actionable.

That is noise.

Why Most Indicators Fail

The investment industry is fixated on indicators — moving averages, oscillators, sentiment surveys, economic data. Most fail as timing tools for a straightforward reason: they were designed for linear systems and applied to a nonlinear one.

A 200-day moving average does not "understand" market regimes. It calculates an average. When prices cross below it, commentators declare "the trend has changed." When prices cross above, "the bull market is back." These signals are slow, laggy, and generate excessive false positives in range-bound markets.

RSI indicates when a market is "overbought" or "oversold" — but markets can remain overbought for months during strong trends and oversold for months during crashes. The indicator provides information, but not *actionable* information.

The fundamental problem with these tools is that they react to noise rather than detecting signal. They measure what price *did*, not when the character of the market has *changed*.

Structural Turns vs. Daily Fluctuations

Daily fluctuations are noise. The market drops 1.5% on a Tuesday due to options mechanics and the headline reads "trade war fears." It rallies 2% on Wednesday on short covering and the headline reads "investor optimism returns." None of this is investable.

Structural turns are signal. The underlying trend has reversed. The cycle has changed. The waveform has inflected. This occurs infrequently — a handful of times per year in most markets — and it is the only information worth acting on.

The entire architecture of The Signal is built around this distinction. The system is not designed to trade daily. It is not designed to capture every 3% pullback. It is designed to identify the handful of moments each year when the regime genuinely changes — and reposition accordingly.

THE PHILOSOPHY

Few trades. Regime-based. Systematic.

The philosophy: remain invested unless the evidence dictates otherwise. When the evidence changes, act. Then wait for the next confirmed turn.

CHAPTER SIX

The Signal in Action

Theory must translate to implementation. THOR's two ETF strategies demonstrate The Signal operating in real-time.

THLV: Sector-Level Regime Detection

THLV — the THOR Equal Weight Low Volatility ETF — monitors 10 U.S. equity sectors and applies The Signal to each independently. Sectors in confirmed risk-on regimes receive equal portfolio weight. Sectors in risk-off regimes are removed.

Illustrative positioning (as of late January 2026):

SECTOR	SIGNAL STATUS
Materials (XLB)	● Risk-On
Energy (XLE)	● Risk-On
Industrials (XLI)	● Risk-On
Consumer Discretionary (XLY)	● Risk-On
Consumer Staples (XLP)	● Risk-On
Healthcare (XLV)	● Risk-On
Utilities (XLU)	● Risk-On
Technology (XLK)	● Risk-Off
Financials (XLF)	● Risk-Off
Real Estate (XLRE)	● Risk-Off

7 of 10 sectors risk-on. Technology, Financials, and Real Estate are off.

Consider the implications. The S&P 500 is approximately 35% technology. A traditional index fund forces full technology exposure regardless of market conditions. The Signal detected structural weakness in technology and rotated the portfolio *out* — systematically, without emotion, before the deterioration deepened.

That is not a prediction. It is not an opinion about whether technology is "overvalued" or "due for a correction." It is what the data shows. If technology recovers and the signal confirms a regime change back to risk-on, the system rotates back in. No ego. No narrative. Only the signal.

THIR: Index-Level Regime Detection

THIR — the THOR Index Rotation ETF — applies the same signal processing discipline at the index level, rotating between the S&P 500, Dow Jones Industrial Average, and Nasdaq 100.

Illustrative positioning:

INDEX	SIGNAL STATUS
Dow Jones (DIA)	● Risk-On (~50%)
S&P 500 (SPY)	● Risk-On (~50%)
Nasdaq 100 (QQQ)	● Risk-Off

The system is positioned approximately 50/50 between the Dow and S&P 500, with the Nasdaq effectively off. The Nasdaq is approximately 60% technology, and The Signal detected a regime change in that sector.

Critically, THIR can move to 100% cash when all three indices show risk-off. This capability — stepping completely aside during sustained market declines — represents the strategy's core drawdown protection mechanism.

What This Demonstrates

Both strategies illustrate The Signal performing its designed function:

1. **Detecting regime changes** at the sector and index level
2. **Rotating systematically** based on confirmed signals, not forecasts
3. **Reducing exposure** to areas of structural weakness while maintaining exposure to strength
4. **Operating without emotion** — the system is indifferent to headlines, narratives, and consensus

Positioning changes when the data changes. That is the feature, not the limitation.

CHAPTER SEVEN

The Thesis

The problem is clear: human emotion systematically destroys investment returns. The asymmetry of losses makes drawdown avoidance the single most important portfolio management discipline. And conventional approaches — whether fundamental, technical, or discretionary — remain compromised by the same behavioral biases they claim to overcome.

THOR built a system that removes the human from the decision.

The system applies signal processing — the same engineering discipline used in noise-canceling technology, radar, and telecommunications — to financial price data. It filters noise, isolates the underlying signal, detects regime changes, and repositions capital accordingly. It does not predict. It detects. It does not debate. It acts.

Key Principles

- **The system is the portfolio manager.** Human judgment built the system. Human judgment does not run it.
- **Regime detection, not market prediction.** The Signal identifies structural turns — not daily fluctuations.
- **Drawdown avoidance is the foundation.** Compounding works only when losses are managed.
- **Discipline is engineered, not aspirational.** The system cannot panic, chase, or capitulate.

About THOR Financial Technologies

THOR Financial Technologies was founded by Brad Roth, CIO, who identified the intersection of behavioral finance and signal processing as the foundation for a systematic investment approach. The insight — that financial markets produce

waveforms amenable to the same filtering techniques used in audio engineering and physics — led to the development of The Signal and its application across THOR's ETF strategies.

The system is the product. The philosophy is the edge.

The Signal is the answer.

Follow The Signal, not the noise.

THOR Financial Technologies applies signal processing — the same engineering discipline used in noise-canceling technology, radar, and telecommunications — to systematic portfolio management. THOR's ETFs — THLV and THIR — implement regime-based sector rotation and index allocation. Learn more at thorfunds.com and thorsignals.com.

Learn More

For institutional inquiries, current ETF positioning, and detailed strategy information.

thorfunds.com

IMPORTANT DISCLOSURES

This white paper is for informational and educational purposes only and does not constitute investment advice, an offer to sell, or a solicitation of an offer to buy any security. Past performance does not guarantee future results. All investments involve risk, including possible loss of principal. THOR's systematic approach does not guarantee profits or protect against losses in declining markets. The Signal is a proprietary system and its methodology is not fully disclosed herein.

ETF positioning data referenced reflects a specific point in time and may not be representative of current or future allocations. Investors should carefully consider investment objectives, risks, charges, and expenses before investing. For more information about THLV and THIR, including prospectus materials, visit thorfunds.com.

ETF shares are bought and sold at market price (not NAV) and are not individually redeemed from the fund.