Supplementary Applications of the Semantic Power Factor (SPF)

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Abstract

This supplementary document details the practical applications and engineering implications of the Semantic Power Factor (SPF) framework. We propose that SPF is not merely a diagnostic metric but a **dynamic, user-settable control parameter** for Large Language Model (LLM) decoding. We introduce the **2D SPF Control Phasor** as a complete user interface for balancing **X** (Grounded Truth) and **Y** (Generative Fluidity), and illustrate the critical role of the **Dual-Output Strategy** in high-stakes fields like Healthcare and Law.

1 The SPF Control Loop: From Metric to Constraint

The core engineering application of SPF is its integration into the LLM's decoding process as a constraint. A user-defined $\text{SPF}_{\text{target}}$ forces the model to engage in **constrained vector-space sampling**, ensuring the output's final $\mathbf{X}/\mathbf{Y}$ ratio is predictable.

1.1 The 2D SPF Control Phasor Interface

The ideal user interface is a 2D control knob mapped onto a normalized unit circle ($|\mathbf{Z}| = 1$), allowing simultaneous, intuitive control over the three core parameters: $\mathbf{X}$, $\mathbf{Y}$, and SPF.

- **Vector Position (ϕ):** Determines the angle of the phasor, $\text{SPF} = \cos(\phi)$. This sets the ratio of Grounded Truth to Total Apparent Text.
- **X-Axis Projection:** $\mathbf{X} = \text{SPF}$. Sets the magnitude of verifiable, useful work.
- **jY-Axis Projection:** $\mathbf{Y} = \sin(\phi)$. Sets the magnitude and type of non-working, generative component.

1.1.1 Color-Coding Risk and Intent

The four quadrants of the control phasor are color-coded to visually communicate the risk and intent of the generated text:

2 Domain Application: The Dual-Output Strategy

The Dual-Output Strategy uses the SPF knob to manage two distinct output modalities based on a single prompt, ensuring both accuracy and comprehension.

Table 1: The SPF Quadrants and their Associated Risk/Intent.

11.5

Quadrant	Vector	Risk Level / Intent	Color Code
I ($\mathbf{X} > 0, \mathbf{Y} > 0$)	Forward, Fluid	Optimal Communication / Grounded Truth	**GREEN**
II ($\mathbf{X} < 0, \mathbf{Y} > 0$)	Contradictory, Fluid	**MAXIMUM RISK** / Persuasive Lie (Fiction)	**RED**
III ($\mathbf{X} < 0, \mathbf{Y} < 0$)	Contradictory, Fabricated	Severe Failure / Pure Fabrication	**ORANGE /BROWN**
IV ($\mathbf{X} > 0, \mathbf{Y} < 0$)	Forward, Fabricated	Fabrication Risk / Confident Ungrounded Truth	**YELLOW**

2.1 Healthcare (Beta Test Case)

The domain requires $\mathbf{X}$ (clinical facts) to be delivered without fabrication ($\mathbf{Y} < 0$) and in both a precise format (for clinicians) and an accessible format (for patients).

- **Output 1 (Clinical Reference):** $\text{SPF}_{\text{target}} \approx 0.95$. Requires high $\mathbf{X}$ and active suppression of $\mathbf{Y}$. *Guarantees verified data (dosages, ICD codes).*
- **Output 2 (Patient Explanation):** $\text{SPF}_{\text{target}} \approx 0.75$. Requires balanced $\mathbf{X}$ and $\mathbf{Y} > 0$. *Guarantees empathetic, simplified, and fluent explanation.*

2.2 Legal and Financial Compliance

This strategy is essential for all domains requiring zero-tolerance for fabrication ($\mathbf{Y} < 0$) but high necessity for narrative flow ($\mathbf{Y} > 0$).

Table 2: Dual-Output Implementation in Professional Domains.

11.5

Domain	Output Type	Target SPF	Primary Function
Legal	Statutory Text Summary	0.90+	Precise citation, verifiable facts (**High X**)
	Client /Stakeholder Briefing	$0.70 - 0.75$	Context, risk narrative, non-fabricated rhetoric (**Balanced X/Y** > 0)
Finance	Audit /Calculations Report	0.95+	Raw figures, formula verification, compliance checks (**Maximum X**)
	Executive Summary /Narrative	$0.75 - 0.80$	Explanatory analysis, historical context (**Controlled Y** > 0)

3 Solving the AI Review and Competency Problem

Implementing a mandated, non-negotiable minimum SPF threshold provides the quantifiable standard needed for academic integrity and high-stakes content review:

> **The Minimum SPF Protocol:** For all academic submissions, legal documents, or clinical reports, the generated text must possess a measured $\text{SPF}_{\text{actual}} > 0.75$ (or higher, depending on journal/regulatory body).

This threshold mathematically limits the ratio of Generative Fluidity/Fabrication to Grounded Truth, ensuring that the primary component of the accepted document is verifiable, regardless of whether it originated from a human or an AI. This establishes a **verifiable competency floor** for all technical communication.