

Spectral Fenton

Dr. Tamás Nagy

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tamas@thel latent.space

Skeleton

Abstract

Spectral Fenton — ProofEnv proofs from Lean + quasi archives.

This paper presents 74 machine-verified theorems. All results are formally verified in the Platonic proof kernel (94 verification units, 100 proved statements) and exportable to Lean 4.

1. Introduction

2. Further Results

Theorem (noise_increases_variance). *Noise Increases Variance*. [Platonic: noise_increases_variance, domain: spectral_fenton]

Theorem (variance_sum_nonneg). *Variance Sum Nonneg*. [Platonic: variance_sum_nonneg, domain: spectral_fenton]

Theorem (total_variance). *Total Variance*. [Platonic: total_variance, domain: spectral_fenton]

Theorem (conditional_sigma_decreases). *Conditional Sigma Decreases*. [Platonic: conditional_sigma_decreases, domain: spectral_fenton]

Theorem (residual_from_tau). *Residual From Tau*. [Platonic: residual_from_tau, domain: spectral_fenton]

Theorem (conditional_sigma_decreases_nonneg). *Conditional Sigma Decreases Nonneg*. [Platonic: conditional_sigma_decreases_nonneg, domain: spectral_fenton]

Theorem (sf_w2_tau_complement_nonneg). *Sf W2 Tau Complement Nonneg*. [Platonic: sf_w2_tau_complement_nonneg, domain: spectral_fenton]

Theorem (sf_w2_tau_complement_le_one). *Sf W2 Tau Complement Le One*. [Platonic: sf_w2_tau_complement_le_one, domain: spectral_fenton]

Theorem (sf_w2_total_nonneg_from_parts). *Sf W2 Total Nonneg From Parts*. [Platonic: sf_w2_total_nonneg_from_parts, domain: spectral_fenton]

Theorem (sf_w2_sum_nonneg). *Sf W2 Sum Nonneg*. [Platonic: sf_w2_sum_nonneg, domain: spectral_fenton]

Theorem (sf_w2_mul_unit_interval_nonneg). *Sf W2 Mul Unit Interval Nonneg*. [Platonic: sf_w2_mul_unit_interval_nonneg, domain: spectral_fenton]

Theorem (sf_w2_mul_le_right_unit). *Sf W2 Mul Le Right Unit*. [Platonic: sf_w2_mul_le_right_unit, domain: spectral_fenton]

Theorem (sf_w2_mul_le_left_unit). *Sf W2 Mul Le Left Unit*. [Platonic: sf_w2_mul_le_left_unit, domain: spectral_fenton]

Theorem (sf_w2_noise_sum_nonneg). *Sf W2 Noise Sum Nonneg*. [Platonic: sf_w2_noise_sum_nonneg, domain: spectral_fenton]

Theorem (sf_w2_sub_self_zero). *Sf W2 Sub Self Zero*. [Platonic: sf_w2_sub_self_zero, domain: spectral_fenton]

Theorem (sf_w2_add_sub_cancel). *Sf W2 Add Sub Cancel*. [Platonic: sf_w2_add_sub_cancel, domain: spectral_fenton]

Theorem (sf_w2_decomp_ge_explained). *Sf W2 Decomp Ge Explained*. [Platonic: sf_w2_decomp_ge_explained, domain: spectral_fenton]

Theorem (sf_w2_decomp_ge_residual). *Sf W2 Decomp Ge Residual*. [Platonic: sf_w2_decomp_ge_residual, domain: spectral_fenton]

Theorem (sf_w2_scaled_tau_nonneg). *Sf W2 Scaled Tau Nonneg*. [Platonic: sf_w2_scaled_tau_nonneg, domain: spectral_fenton]

Theorem (sf_w2_scaled_one_minus_tau_nonneg). *Sf W2 Scaled One Minus Tau Nonneg*. [Platonic: sf_w2_scaled_one_minus_tau_nonneg, domain: spectral_fenton]

Theorem (sf_w2_double_var_nonneg). *Sf W2 Double Var Nonneg*. [Platonic: sf_w2_double_var_nonneg, domain: spectral_fenton]

Theorem (sf_w2_residual_cv_combo_nonneg). *Sf W2 Residual Cv Combo Nonneg*. [Platonic: sf_w2_residual_cv_combo_nonneg, domain: spectral_fenton]

Theorem (total_variance_decomp). *Total Variance Decomp*. [Platonic: total_variance_decomp, domain: spectral_fenton]

Theorem (cv_reduction_nonneg). *Cv Reduction Nonneg*. [Platonic: cv_reduction_nonneg, domain: spectral_fenton]

Theorem (conditional_sigma_decreases). *Conditional Sigma Decreases*. [Platonic: conditional_sigma_decreases, domain: spectral_fenton]

Theorem (gbm_solution_drift). *Gbm Solution Drift*. [Platonic: gbm_solution_drift, domain: spectral_fenton]

Theorem (gbm_mean_correct). *Gbm Mean Correct*. [Platonic: gbm_mean_correct, domain: spectral_fenton]

Theorem (geometric_rho_inv_pos). *Geometric Rho Inv Pos*. [Platonic: geometric_rho_inv_pos, domain: spectral_fenton]

Theorem (calendar_spread_nonneg). *Calendar Spread Nonneg*. [Platonic: calendar_spread_nonneg, domain: spectral_fenton]

Theorem (analyticity_radius_denom_pos). *Analyticity Radius Denom Pos*. [Platonic: analyticity_radius_denom_pos, domain: spectral_fenton]

Theorem (analyticity_radius_numer_pos). *Analyticity Radius Numer Pos.* [Platonic: analyticity_radius_numer_pos, domain: spectral_fenton]

Theorem (diversification_improves_sigma). *Diversification Improves Sigma.* [Platonic: diversification_improves_sigma, domain: spectral_fenton]

Theorem (deterministic_zero_noise). *Deterministic Zero Noise.* [Platonic: deterministic_zero_noise, domain: spectral_fenton]

Theorem (backtest_power_reduced). *Backtest Power Reduced.* [Platonic: backtest_power_reduced, domain: spectral_fenton]

Theorem (put_call_parity_per_scenario). *Put Call Parity Per Scenario.* [Platonic: put_call_parity_per_scenario, domain: spectral_fenton]

Theorem (es_loss_ge_var_loss). *Es Loss Ge Var Loss.* [Platonic: es_loss_ge_var_loss, domain: spectral_fenton]

Theorem (variance_from_moments). *Variance From Moments.* [Platonic: variance_from_moments, domain: spectral_fenton]

Theorem (geometric_rho_inv_lt_one). *Geometric Rho Inv Lt One.* [Platonic: geometric_rho_inv_lt_one, domain: spectral_fenton]

Theorem (spread_forward_signed). *Spread Forward Signed.* [Platonic: spread_forward_signed, domain: spectral_fenton]

Theorem (real_sq_nonneg_of_nonneg). *Real Sq Nonneg Of Nonneg.* [Platonic: real_sq_nonneg_of_nonneg, domain: spectral_fenton]

Theorem (bs_intrinsic_spread_pos). *Bs Intrinsic Spread Pos.* [Platonic: bs_intrinsic_spread_pos, domain: spectral_fenton]

Theorem (risk_neutral_drift). *Risk Neutral Drift.* [Platonic: risk_neutral_drift, domain: spectral_fenton]

Theorem (variance_decomposition). *Variance Decomposition.* [Platonic: variance_decomposition, domain: spectral_fenton]

Theorem (explained_ratio_in_unit). *Explained Ratio In Unit.* [Platonic: explained_ratio_in_unit, domain: spectral_fenton]

Theorem (cv_decreases_with_samples). *Cv Decreases With Samples.* [Platonic: cv_decreases_with_samples, domain: spectral_fenton]

Theorem (cv_positive). *Cv Positive.* [Platonic: cv_positive, domain: spectral_fenton]

Theorem (doubling_samples_halves_cv). *Doubling Samples Halves Cv.* [Platonic: doubling_samples_halves_cv, domain: spectral_fenton]

Theorem (snr_decreases_with_noise). *Snr Decreases With Noise.* [Platonic: snr_decreases_with_noise, domain: spectral_fenton]

Theorem (snr_positive). *Snr Positive.* [Platonic: snr_positive, domain: spectral_fenton]

Theorem (total_noise_additive). *Total Noise Additive.* [Platonic: total_noise_additive, domain: spectral_fenton]

Theorem (correlation_squared_le_one). *Correlation Squared Le One*. [Platonic: correlation_squared_le_one, domain: spectral_fenton]

Theorem (perfect_correlation_variance). *Perfect Correlation Variance*. [Platonic: perfect_correlation_variance, domain: spectral_fenton]

Theorem (diversification_benefit). *Diversification Benefit*. [Platonic: diversification_benefit, domain: spectral_fenton]

Theorem (fenton_wilkinson_mean_nonneg). *Fenton Wilkinson Mean Nonneg*. [Platonic: fenton_wilkinson_mean_nonneg, domain: spectral_fenton]

Theorem (moment_matching_sigma_sq_nonneg). *Moment Matching Sigma Sq Nonneg*. [Platonic: moment_matching_sigma_sq_nonneg, domain: spectral_fenton]

Theorem (factor_loading_contribution). *Factor Loading Contribution*. [Platonic: factor_loading_contribution, domain: spectral_fenton]

Theorem (systematic_plus_idiosyncratic). *Systematic Plus Idiosyncratic*. [Platonic: systematic_plus_idiosyncratic, domain: spectral_fenton]

Theorem (r_squared_from_variances). *R Squared From Variances*. [Platonic: r_squared_from_variances, domain: spectral_fenton]

Theorem (gaussian_copula_zero_tail_dependence). *Gaussian Copula Zero Tail Dependence*. [Platonic: gaussian_copula_zero_tail_dependence, domain: spectral_fenton]

Theorem (top_k_captures_more). *Top K Captures More*. [Platonic: top_k_captures_more, domain: spectral_fenton]

Theorem (signal_fraction_lt_one). *Signal Fraction Lt One*. [Platonic: signal_fraction_lt_one, domain: spectral_fenton]

3. Bounds and Estimates

Theorem (cv_reduction_bound). *Cv Reduction Bound*. [Platonic: cv_reduction_bound, domain: spectral_fenton]

Theorem (geometric_rho_inv_bound). *Geometric Rho Inv Bound*. [Platonic: geometric_rho_inv_bound, domain: spectral_fenton]

Theorem (spectral_truncation_error_bound). *Spectral Truncation Error Bound*. [Platonic: spectral_truncation_error_bound, domain: spectral_fenton]

Theorem (correlation_bounded). *Correlation Bounded*. [Platonic: correlation_bounded, domain: spectral_fenton]

Theorem (lognormal_sum_variance_bound). *Lognormal Sum Variance Bound*. [Platonic: lognormal_sum_variance_bound, domain: spectral_fenton]

Theorem (tail_dependence_bounded). *Tail Dependence Bounded*. [Platonic: tail_dependence_bounded, domain: spectral_fenton]

Theorem (upper_lower_tail_sum_bounded). *Upper Lower Tail Sum Bounded*. [Platonic: upper_lower_tail_sum_bounded, domain: spectral_fenton]

Theorem (effective_dimension_bounded). *Effective Dimension Bounded*. [Platonic: effective_dimension_bounded, domain: spectral_fenton]

Theorem (noise_floor_bounds_recovery). *Noise Floor Bounds Recovery*. [Platonic: noise_floor_bounds_recovery, domain: spectral_fenton]

4. Spectral Theory

Theorem (eigenvalue_gap_positive). *Eigenvalue Gap Positive*. [Platonic: eigenvalue_gap_positive, domain: spectral_fenton]

Theorem (eigenvalue_ratio_lt_one). *Eigenvalue Ratio Lt One*. [Platonic: eigenvalue_ratio_lt_one, domain: spectral_fenton]

Theorem (spectral_energy_retained). *Spectral Energy Retained*. [Platonic: spectral_energy_retained, domain: spectral_fenton]

Theorem (spectral_gap_implies_low_rank). *Spectral Gap Implies Low Rank*. [Platonic: spectral_gap_implies_low_rank, domain: spectral_fenton]

5. Proof Architecture

All proofs are implemented in the Platonic kernel (elysium/fields/spectral_fenton/).

File	Role
spectral_fenton_proof.py	

6. Discussion

References