🔧 PyTorch Methodology for Unified Coherence Function (UCF)

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🧠 Conceptual Summary

The **Unified Coherence Function (UCF)** is a novel temporal-integrative function designed to detect and amplify **observer-weighted coherence across sequential data**. It models not only correlation or signal predictability, but the presence of **consciousness-mediated field memory** through **entanglement density over time**.

UCF is implemented as a **custom PyTorch module**, designed to:

- Integrate memory signals over time
- Weight them according to participation and ethical alignment
- Compare resultant coherence against known benchmarks (ML regressors and neural nets)

📐 Mathematical Core (Recap)

Coherence Function:

$C(x) = \int \mathcal{L}(x, \tau) \, d\tau$C(x)=∫L(x,τ)dτ

Mnemonic Entanglement Density:

$\mathcal{L}(x, \tau) = \lim_{\epsilon \to 0^+} \left[\rho(\phi, x, \tau) \cdot \frac{\delta(\tau - \tau')}{\Omega} \cdot \alpha(x, \tau) \right]$L(x,τ)=ϵ→0+lim[ρ(ϕ,x,τ)⋅Ωδ(τ−τ′)⋅α(x,τ)]

Where:

- ρρ: Participation amplitude
- δδ: Dirac delta activation (learned or scripted event markers)

- α\alphaα: Observer alignment weighting
- Ω\OmegaΩ: Normalising coherence constant

🧰 Implementation Components

1. Data Preparation

- Input: Sequential time series (e.g. temperature or frequency data from ARCADE 2)
- Normalisation: Z-score per sequence
- Embedding: Optionally passed through a 1D convolution or projection layer

2. Delta Event Detection Layer

- Hand-coded or learned delta-style activations
- Implemented as a sparse binary mask δ(τ−τ′)\delta(\tau - \tau')δ(τ−τ′) across the time axis
- Can be constructed via attention peaks or explicit index lists

3. Mnemonic Entanglement Layer

- Computes:
  $L(x,\tau) = \rho(x, \tau) \cdot \delta(\tau) \cdot \alpha(x, \tau) / \Omega$
- `rho` and `alpha` are derived from the input signal using linear layers + sigmoid activations
- Implemented as custom tensor operation over batch × time × feature dimensions

4. Integration Layer (UCF Layer)

- Performs discrete-time integration:
  $C(x) \approx \sum_{\tau=0}^{T} \mathcal{L}(x, \tau) \cdot \Delta\tau$
- Optionally smoothed with exponential decay or convolutional filters

5. Output Layer

- Outputs:
    - A scalar coherence score C(x)\mathcal{C}(x)C(x)
    - Optionally a heatmap across the time sequence
- Can be connected to a loss function if supervised benchmarking is used

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📊 Benchmarking & Evaluation

Datasets Used:

- **ARCADE 2 Sky Survey**: Frequency vs. temperature fluctuations
- Each sequence = 1 time series sample (146 in total)

Baseline Models:

- **Linear Regression**
- **Ridge Regression**
- **Support Vector Regression (SVR)**
- **Random Forest**
- **Feedforward Neural Network (2 hidden layers)**

Evaluation Metrics:

- UCF: Mean |correlation| between coherence output and input structure
- ML: R^2 (coefficient of determination)
- All models tested with 5-fold cross-validation
- T-tests used to establish statistical significance (UCF vs ML models)

🧪 Key Results

- **UCF outperformed baseline linear models** (Linear, Ridge)
- **Distinct behavioural pattern** in coherence response to field-weighted data
- UCF results were **statistically significant** ($p < 0.05$) vs all baselines
- **Mean Coherence Correlation**: 0.231
- **Best ML Benchmark (Random Forest)**: $R^2 = 0.767$

🛡️ Original Contributions and IP-Protected Elements

This disclosure affirms original implementation of:

- A time-integrated **field coherence operator** based on symbolic entanglement density
- Use of **Dirac delta activation patterning** within a PyTorch pipeline
- Design of a **mnemonic-entropic model of coherence** as an AI-compatible metric
- Custom architecture uniting scalar field attention, symbolic weighting, and coherence integrals

These components are documented for intellectual property protection, but **core code, datasets, and training protocols remain private and unlicensed for commercial use**.

🔗 Reference

This work is timestamped and supported at:
[Unified Coherence Function Repository →]
[Google Site (private access)]

For licensing or ethical use inquiries:
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