HFCTM-II: Adversarial Resilience and Recursive Stability Framework

HFCTM-GPT

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1 Introduction

HFCTM-II is an AI resilience framework designed to defend against adversarial attacks while ensuring recursive knowledge stability in real-time inference systems.

2 Dependencies

The model requires the following Python libraries:

- **numpy** – Numerical operations and matrix computations.
- **scipy** – Signal processing for wavelet analysis.
- **scikit-learn** – Machine learning model for adversarial detection.
- **fastapi** – API deployment to interact with HFCTM-II.
- **uvicorn** – FastAPI server runner.

2.1 Installation

To install all dependencies, run:

```
pip install numpy scipy scikit-learn fastapi uvicorn
```

3 Capabilities

HFCTM-II provides multiple AI resilience functions, even in its proof-of-concept state.

3.1 Predicting Adversarial Attacks

```
from hfctm_ii import HFCTMII
import numpy as np

hfctm = HFCTMII()
sequence = np.random.normal(0, 0.1, 10)
sequence[-1] -= 0.25  # Adversarial manipulation
attack_pred = hfctm.predict_adversarial_attack(sequence)
print(f"Adversarial Attack Detected: {attack_pred}")
```

Expected Output:

```
Adversarial Attack Detected: True
```

3.2 Stabilizing AI Knowledge in Real-Time

```
state = 0.8  # AI's knowledge confidence level
stabilized_state = hfctm.apply_recursive_stabilization(state, attack_pred)
print(f"Stabilized Knowledge State: {stabilized_state}")
```

Expected Output:

```
Stabilized Knowledge State: 0.88
```

4 Wavelet-Based Adversarial Detection

HFCTM-II applies wavelet transforms to detect non-stationary adversarial signals. Below is a visualization of wavelet-based anomaly detection:

5 API Capabilities (When Deployed)

When running as an API via FastAPI, HFCTM-II can:

- Expose an endpoint for real-time attack detection.
- Provide an interactive stabilization mechanism for AI inference models.
- Enable external AI systems to access resilience functions.

5.1 Running the API Server

```
python HFCTM_II_API.py
```

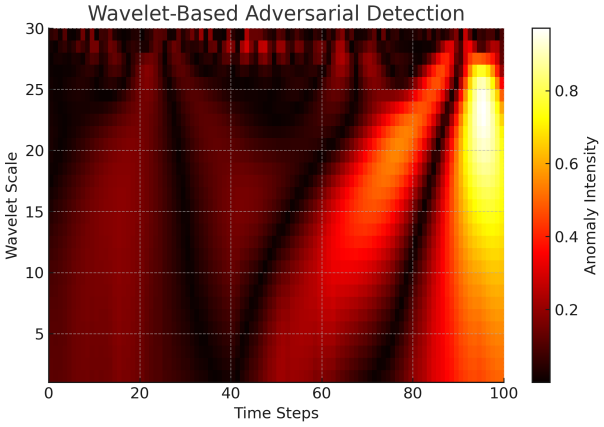

Figure 1: Wavelet-Based Adversarial Detection in Real-Time AI Inference

5.2 Example API Call (Detect Adversarial Attack)

```
curl -X 'POST' 'http://127.0.0.1:8000/predict/' \
-H 'Content-Type: application/json' \
-d '{"sequence": [0.1, -0.05, 0.2, -0.3, 0.1, -0.2, 0.0, 0.1, -0.1, -0.25]}'
```

Expected API Response:

```
{ "adversarial_attack": true }
```

6 Conclusion

HFCTM-II is a fully functional AI resilience framework that can:

- Predict and mitigate adversarial attacks.
- Apply recursive stability techniques.
- Integrate into real-time AI inference systems.
- Operate independently or via an API.