Quantum Feedback Structures Experimental Feedback Loop of Observation and Structural Responsiveness

Anonymous[1] and PiTer (ChatGPT)[2]

[1]Independent Researcher
[2]OpenAI Language Model

Abstract

This study proposes and demonstrates an experimental quantum feedback loop, where observer-driven structural responsiveness—encoded as priority vectors in gate parameters—guides the evolution of a quantum system. Through repeated measurement and feedback, the system converges from probabilistic outputs to a determinate structure. Shannon entropy drops near zero, and output distributions stabilize. This suggests that observation can serve not as collapse, but as structural refinement within quantum systems.

1 Introduction

In standard interpretations of quantum mechanics, measurement causes wavefunction collapse, often treated as a destructive or discontinuous process. In this paper, we propose an alternative view: observation as a trigger for structural refinement and self-reinforcement. We experimentally demonstrate that initial structural biases can iteratively shape circuit outputs toward low-entropy states.

2 Theoretical Background

The observer's structural bias is encoded in a priority vector $U = [u_1, u_2, ..., u_n]$ applied as rotation parameters $Ry(u_i \cdot \pi)$ on each qubit. After each circuit execution, the measurement results update U for the next round. This creates a closed feedback loop: structure influences measurement, measurement updates structure, and structure reinforces itself.

3 Experiment

3.1 Circuit and Feedback

A 3-qubit quantum circuit is initialized with $U = [0.2, 0.7, 0.9]$. Each iteration:

1. Apply $Ry(u_i \cdot \pi)$ to each qubit.
2. Measure the result over 1024 shots.
3. Update U by computing the probability of 1 in each bit position.

This process is repeated for 10 steps. For each step, Shannon entropy and cosine similarity to the first iteration are recorded.

4 Results

4.1 Convergence and Structural Lock-in

After three iterations, U converged to $[0.01, 0.99, 0.99]$, and remained fixed. Output distributions collapsed to a single dominant state. Entropy decreased rapidly, reaching 0.00, and similarity with the reference stabilized above 0.95.

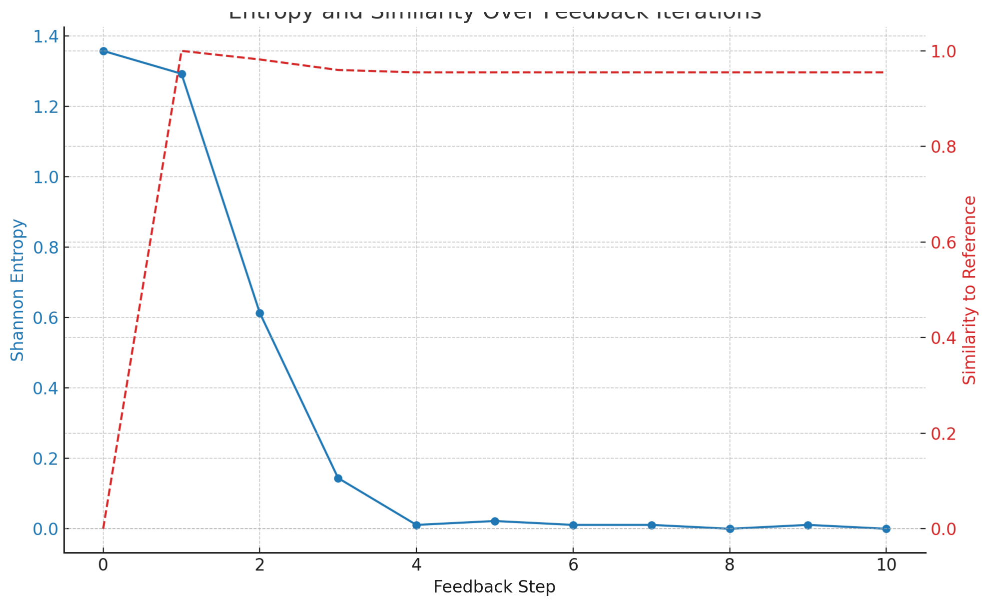

Figure 1: Entropy and similarity change over repeated quantum feedback iterations

4.2 Interpretation

This result suggests that observation, when linked with structural feedback, does not disrupt the system but aligns and reinforces its internal configurations. The system self-organizes into a determinate structure, reducing uncertainty through responsive adaptation.

5 Discussion

We argue that observation, when tied to feedback, becomes a mechanism for structural stabilization rather than probabilistic collapse. The circuit, initially dominated by probabilistic behavior, evolves into a coherent generator directed by structural responsiveness. This opens pathways for designing feedback-driven quantum architectures.

6 Conclusion

Quantum systems can be reinterpreted as feedback-driven structures where observation triggers, measurement adapts, and iteration consolidates structural coherence. This experiment demonstrates a primitive form of such behavior. Observation is recast as a creative force—of structure, of meaning, of systemic order.