Novelty Assessment Report

Paper: Dynamical properties of dense associative memory

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Abstract

Dense associative memory, a fundamental instance of modern Hopfield networks, can store a large number of memory patterns as equilibrium states of recurrent networks. While the stationary-state storage capacity has been investigated, its dynamical properties have not yet been discussed. In this paper, we analyze the dynamics using an exact approach based on generating functional analysis. We show results on convergence properties of memory retrieval, such as the convergence time and the size of the attraction basins. Our analysis enables a quantitative evaluation of the convergence time and the storage capacity of dense associative memory, which is useful for model design. Unlike the traditional Hopfield model, the retrieval of a pattern does not act as additional noise to itself, suggesting that the structure of modern networks makes recall more robust. Furthermore, the methodology addressed here can be applied to other energy-based models, and thus has the potential to contribute to the design of future architectures.

Disclaimer

This report is **AI-GENERATED** using Large Language Models and WisPaper (a scholar search engine). It analyzes academic papers' tasks and contributions against retrieved prior work. While this system identifies **POTENTIAL** overlaps and novel directions, **ITS COVERAGE IS NOT EXHAUSTIVE AND JUDGMENTS ARE APPROXIMATE**. These results are intended to assist human reviewers and **SHOULD NOT** be relied upon as a definitive verdict on novelty.

Note that some papers exist in multiple, slightly different versions (e.g., with different titles or URLs). The system may retrieve several versions of the same underlying work. The current automated pipeline does not reliably align or distinguish these cases, so human reviewers will need to disambiguate them manually.

If you have any questions, please contact: mingzhang23@m.fudan.edu.cn

Core Task Landscape

This paper addresses: **Dynamical Properties of Dense Associative Memory Networks**

A total of **50 papers** were analyzed and organized into a taxonomy with **20 categories**.

Taxonomy Overview

The research landscape has been organized into the following main categories:

- **Dense Associative Memory Models and Architectures**
- **Bidirectional Associative Memory Neural Networks**
- **Classical and Variant Hopfield Networks**
- **Oscillatory and Phase-Based Associative Memory**
- **Nonequilibrium and Quantum Associative Memory**
- **Theoretical Extensions and Mathematical Frameworks**
- **Sequence Memory and Temporal Dynamics**
- **Hardware Implementations and Physical Realizations**
- **Robustness, Optimization, and Practical Enhancements**
- **Applications and Interdisciplinary Connections**
- ... and 1 more categories

Complete Taxonomy Tree

- Dynamical Properties of Dense Associative Memory Networks Survey Taxonomy
- Dense Associative Memory Models and Architectures
  - Core Dense Associative Memory Theory ★ (4 papers)
  - [0] Dynamical properties of dense associative memory (Anon et al., 2026) View paper
  - [1] Transient dynamics of associative memory models (Clark, 2025) View paper
  - [11] Saddle Hierarchy in Dense Associative Memory (Tantari, 2025) View paper
  - [18] Effects of Feature Correlations on Associative Memory Capacity (Friedland, 2025) View paper
  - Hierarchical and Structured Dense Associative Memory (2 papers)
  - [3] Semantically-correlated memories in a dense associative model (Burns, 2024) View paper
  - [5] Hierarchical associative memory (Krotov, 2021) View paper
  - Sequential and Continual Learning in Dense Associative Memory (2 papers)
  - [6] Autonomous retrieval for continuous learning in associative memory networks (Rozenberg, 2025) View paper
  - [12] Sequential Learning in the Dense Associative Memory (H. A. McAlister, 2025) View paper
  - Biological and Neuromorphic Implementations (3 papers)
  - [9] Episodic and associative memory from spatial scaffolds in the hippocampus (Sarthak Chandra, 2024) View paper
  - [19] Large associative memory problem in neurobiology and machine learning (Krotov, 2020) View paper
  - [20] Neuromodulation-inspired gated associative memory networks: extended memory retrieval and emergent multistability (Daiki Goto, 2025) View paper
- Bidirectional Associative Memory Neural Networks
  - Fractional-Order BAM Dynamics and Bifurcation (2 papers)
  - [2] Further analysis on dynamical properties of fractionalâorder biâdirectional associative memory neural networks involving double delays (Changjin Xu, 2022) View paper
  - [7] Bifurcation Analysis of Time-Delayed Non-Commensurate Caputo Fractional Bi-Directional Associative Memory Neural Networks Composed of Three Neurons (Cheng-qiang Wang, 2024) View paper
  - Integer-Order BAM with Time Delays (5 papers)

  - [4] Mathematical study on bifurcation dynamics and control mechanism of triâ□□neuron bidirectional associative memory neural networks including delay (Wei-Bo Ou, 2023) View paper
  - [10] New Insights on Bidirectional Associative Memory Neural Networks with Leakage Delay Components and Time-Varying Delays Using Sampled-Data Control (S. R. Chandra, 2024) View paper
  - [14] Convergence dynamics of hybrid bidirectional associative memory neural networks with distributed delays (X. Liao, 2003) View paper
  - [17] Bifurcation analysis of delayed bidirectional associative memory neural networks (Min Xiao, 2013) View paper
  - [30] Time-Delayed Inertial Bidirectional Associative Memory Neural Network: A Dynamical Exploration (Sangeetha Rajendran, 2023) View paper
  - Impulsive and Fuzzy BAM Models (3 papers)
  - [16] Dynamics of fuzzy impulsive bidirectional associative memory neural networks with time-varying delays (R. Rakkiyappan, 2012) View paper
  - [29] Impulsive Multidirectional Associative Memory Neural Networks: New Results (Chaouki Aouiti, 2021) View paper
  - [44] Dynamical analysis of fuzzy BAM neural networks with variable delays (Qianhong Zhang, 2012) View paper
  - Large-Scale and Spatiotemporal BAM Networks (1 papers)
  - [31] Spatiotemporal Evolution of Large-Scale Bidirectional Associative Memory Neural Networks With Diffusion and Delays (Yunxiang Lu, 2023) View paper
- Classical and Variant Hopfield Networks
  - Classical Hopfield Network Dynamics (2 papers)
  - [15] Dynamics of Associative Memory Networks (Alan M.N. Fu, 2019) View paper
  - [27] Associative dynamics in a chaotic neural network (Masaharu Adachi, 1997) View paper
  - Recurrent Correlation and High-Capacity Variants (2 papers)
  - [24] Recurrent correlation associative memories (T. Chiueh, 1991) View paper
  - [32] Analysis and Design of Multivalued High-Capacity Associative Memories Based on Delayed Recurrent Neural Networks. (Zhang Jiahui, 2022) View paper
  - Multistable and Discontinuous Activation Networks (1 papers)
  - [33] Finite-Time Multisynchronization of Coupled Discontinuous Cohen-Grossberg Neural Networks and Its Application in Associative Memory (Yang Liu, 2025) View paper
- Oscillatory and Phase-Based Associative Memory
  - Kuramoto-Type Oscillator Networks (2 papers)
  - [22] Enhanced Error-free Retrieval in Kuramoto-type Associative-memory Networks via Two-memory Configuration (Li, 2025) View paper
  - [28] Higher-Order Kuramoto Oscillator Network for Dense Associative Memory (Berloff, 2025) View paper
  - Inhibition-Delay and Temporal Encoding (1 papers)
  - [37] Inhibition delay increases neural network capacity through Stirling transform. (Alain Nogaret, 2025) View paper
- Nonequilibrium and Quantum Associative Memory (2 papers)
  - [13] Nonequilibrium Thermodynamics of Associative Memory Continuous-Time Recurrent Neural Networks (Miguel Aguilera, 2025) View paper
  - [21] High-capacity associative memory in a quantum-optical spin glass (Marsh, 2025) View paper
- Theoretical Extensions and Mathematical Frameworks (2 papers)
  - [42] Dense associative memory on the Bures-Wasserstein space (Tankala, 2025) View paper
  - [50] Dense Associative Memory Through the Lens of Random Features (Benjamin Hoover, 2024) View paper
- Sequence Memory and Temporal Dynamics (3 papers)
  - [23] Dynamics of storage and recall in hippocampal associative memory networks (Bruce Graham, 2003) View paper
  - [25] Episodic memory theory of recurrent neural networks: Insights into long-term information storage and manipulation (A Karuvally, 2023) View paper
  - [49] Long Sequence Hopfield Memory (Hamza Tahir Chaudhry, 2023) View paper
- Hardware Implementations and Physical Realizations (4 papers)
  - [34] Largeâ□□Scale and Highly Reliable Hopfield Neural Networks Using Vertical NAND Flash Memory for the Inâ□□Memory Associative Computing (JH Chang, 2025) View paper
  - [35] Dense Associative Memory in a Nonlinear Optical Hopfield Neural Network (Kumar Santosh, 2025) View paper
  - [36] Dense Associative Memories with Analog Circuits (Marc Gong Bacvanski, 2025) View paper
  - [43] High-Density Digital Neuromorphic Processor with High-Precision Neural and Synaptic Dynamics and Temporal Acceleration (Jong-Kil Park, 2024) View paper
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  - [38] Improved Robustness and Hyperparameter Selection in the Dense Associative Memory (Robins, 2024) View paper
  - [45] Unipolar terminal-attractor based neural associative memory with adaptive threshold (Barhen, 1993) View paper
  - [46] Enhancing Storage Capabilities of Oscillatory Neural Networks as Associative Memory (Manuel Jimenez-Traves, 2022) View paper
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  - [26] A practical guide to neural nets (M McCord-Nelson, 1991) View paper
  - [39] A temporal densely connected recurrent network for event-based human pose estimation (Shao, 2023) View paper
  - [41] Opinion Dynamics with Hopfield Neural Networks (Stauffer, 2022) View paper
  - [48] Analysis and synthesis techniques for Hopfield type synchronous discrete time neural networks with application to associative memory (A.N. Michel, 1990) View paper
- Synaptic Connectivity and Network Structure (3 papers)
  - [8] Optimal degrees of synaptic connectivity (Ashok Litwin-Kumar, 2017) View paper
  - [40] High-Density MEA Reveals Distinct Sharp-Wave Ripple Network Dynamics Across Induction Methods in the Hippocampus (Shahrukh Khanzada, 2025) View paper
  - [47] The Role of Post-Encoding Activation of the Prefrontal Cortex in the Differential Organization of Recent and Remote Memories (Marvian, 2023) View paper

Narrative

Core task: Dynamical properties of dense associative memory networks. The field encompasses a rich landscape of models and methods for understanding how neural networks store and retrieve patterns through collective dynamics. At the highest level, the taxonomy distinguishes between foundational architectures—such as Dense Associative Memory Models and Architectures, Classical and Variant Hopfield Networks, and Bidirectional Associative Memory Neural Networks—and more specialized directions including Oscillatory and Phase-Based Associative Memory, Nonequilibrium and Quantum Associative Memory, and Sequence Memory and Temporal Dynamics. Additional branches address Theoretical Extensions and Mathematical Frameworks, Hardware Implementations and Physical Realizations, Robustness and Optimization, Applications and Interdisciplinary Connections, and Synaptic Connectivity and Network Structure. Representative works illustrate this diversity: Semantically Correlated Memories[3] explores how semantic structure influences storage, while Hierarchical Associative Memory[5] examines multi-level organization, and Optimal Synaptic Connectivity[8] investigates the role of network topology in memory performance.

Several active lines of work reveal key trade-offs and open questions. One prominent theme concerns the interplay between network density, capacity, and retrieval dynamics: studies such as Feature Correlations Capacity[18] and Saddle Hierarchy[11] probe how correlations among stored patterns and the geometry of energy landscapes shape memory performance. Another thread examines transient and sequential dynamics, with Transient Dynamics[1] and Sequential Learning Dense[12] addressing how networks evolve over time and learn temporal sequences. The original paper, Dense Associative Memory[0], sits squarely within the core theoretical branch, focusing on fundamental dynamical properties of densely connected networks. Its emphasis on rigorous analysis of retrieval dynamics and capacity limits places it close to works like Saddle Hierarchy[11] and Feature Correlations Capacity[18], which similarly investigate the mathematical underpinnings of pattern storage and the structure of attractor basins, though Dense Associative Memory[0] appears to prioritize a more general framework for understanding dense connectivity effects.

Related Works in Same Category

The following **3 sibling papers** share the same taxonomy leaf node with the original paper:

1. Transient dynamics of associative memory models

Authors: Clark, David G., David G. Clark | **Year/Venue**: 2025 | **URL**: View paper

Abstract

Associative memory models such as the Hopfield network and its dense generalizations with higher-order interactions exhibit a"blackout catastrophe"--a discontinuous transition where stable memory states abruptly vanish when the number of stored patterns exceeds a critical capacity. This transition is often interpreted as rendering networks unusable beyond capacity limits. We argue that this interpretation is largely an artifact of the equilibrium perspective. We derive dynamical mean-field equat...

Relationship Analysis

Both papers belong to the Core Dense Associative Memory Theory category, employing statistical mechanics methods to analyze dense associative memory dynamics. They overlap in studying convergence properties, capacity, and dynamical behavior of modern Hopfield networks with higher-order interactions. The original paper uses generating functional analysis to derive exact asymptotic dynamics with focus on convergence time and retarded self-interaction effects, while the candidate paper employs dynamical mean-field theory via bipartite cavity methods to study transient retrieval dynamics above capacity, emphasizing graceful degradation rather than catastrophic failure.

2. Saddle Hierarchy in Dense Associative Memory

Authors: Tantari, Daniele, Robin Th'eriault, Daniele Tantari | **Year/Venue**: 2025 | **URL**: View paper

Abstract

Dense associative memory (DAM) models have been attracting renewed attention since they were shown to be robust to adversarial examples and closely related to state-of-the-art machine learning paradigms, such as the attention mechanisms in transformers and generative diffusion models. We study a DAM built upon a three-layer Boltzmann machine with Potts hidden units, which represent data clusters and classes. Through a statistical mechanics analysis, we derive saddle-point equations that characte...

Relationship Analysis

Both papers belong to the Core Dense Associative Memory Theory category, analyzing foundational properties of dense associative memory networks using statistical mechanics methods. They overlap in studying dense associative memory dynamics, capacity, and energy landscapes, but differ fundamentally in their approaches: the original paper uses generating functional analysis to characterize convergence properties and retrieval dynamics of Krotov's model, while the candidate paper employs replica method and saddle-point analysis to study a three-layer Boltzmann machine variant with Potts hidden units for classification tasks.

3. Effects of Feature Correlations on Associative Memory Capacity

Authors: Friedland, Gerald, Stefan Bielmeier, Gerald Friedland | **Year/Venue**: 2025 | **URL**: View paper

Abstract

We investigate how feature correlations influence the capacity of Dense Associative Memory (DAM), a Transformer attention-like model. Practical machine learning scenarios involve feature-correlated data and learn representations in the input space, but current capacity analyses do not account for this. We develop an empirical framework to analyze the effects of data structure on capacity dynamics. Specifically, we systematically construct datasets that vary in feature correlation and pattern sep...

Relationship Analysis

Both papers belong to the Core Dense Associative Memory Theory category, analyzing foundational properties of dense associative memory networks using statistical mechanics approaches. The original paper focuses on exact dynamical analysis using generating functional methods to characterize convergence time, attraction basins, and retrieval dynamics in the large-system limit. The candidate paper takes an empirical approach to investigate how feature correlations and pattern separation (measured via Hamming distance) affect storage capacity, bridging theoretical predictions with practical data scenarios rather than providing asymptotic dynamical equations.

Contributions Analysis

Overall novelty summary. The paper contributes an asymptotically exact analysis of dense associative memory dynamics using generating functional methods, focusing on convergence time, basin size, and storage capacity. It resides in the 'Core Dense Associative Memory Theory' leaf, which contains only four papers total, indicating a relatively sparse research direction within the broader taxonomy of 50 papers across 20 leaf nodes. This leaf explicitly focuses on foundational analyses of dense memory dynamics and capacity using statistical mechanics or generating functional approaches, distinguishing it from hierarchical extensions, sequential learning mechanisms, and biological implementations.

The taxonomy reveals that dense associative memory theory sits within a larger branch of 'Dense Associative Memory Models and Architectures' containing 13 papers across four leaves. Neighboring directions include hierarchical and structured variants (2 papers), sequential and continual learning (2 papers), and biological/neuromorphic implementations (3 papers). The broader field also encompasses classical Hopfield networks (5 papers), bidirectional associative memory models (11 papers), and oscillatory/phase-based approaches (3 papers). The original paper's focus on fundamental dynamical properties using exact mathematical methods positions it at the theoretical core, distinct from application-oriented or architecture-specific extensions.

Among 20 candidates examined across three contributions, the analysis found limited prior work overlap. The asymptotically exact dynamical analysis examined 10 candidates with no clear refutations, suggesting novelty in the methodological approach. The quantitative characterization of convergence properties examined 10 candidates and found 1 potentially refutable match, indicating some existing work on convergence metrics but possibly with different analytical frameworks. The insight into robustness was not evaluated against candidates. Given the limited search scope of 20 papers from semantic search and citation expansion, these statistics suggest moderate novelty but do not constitute an exhaustive literature review.

Based on the top-20 semantic matches examined, the work appears to offer methodological contributions in a relatively sparse theoretical area, with most novelty concentrated in the exact dynamical analysis approach. The single refutable match for convergence characterization suggests some overlap with existing quantitative studies, though the specific generating functional methodology may differentiate this work. The analysis does not cover the full breadth of the 50-paper taxonomy, leaving open the possibility of additional relevant work in neighboring branches or more distant research directions.

This paper presents **3 main contributions**, each analyzed against relevant prior work:

Contribution 1: Asymptotically exact dynamical analysis of dense associative memory

Description: The authors present the first asymptotically exact analysis of the dynamical properties of dense associative memory in the large-system limit. They employ generating functional analysis (GFA), a method previously used for traditional Hopfield models but not yet applied to modern Hopfield networks like dense associative memory.

This contribution was assessed against **10 related papers** from the literature. Papers with potential prior art are analyzed in detail with textual evidence; others receive brief assessments.

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1. Transient dynamics of associative memory models

URL: View paper

Brief Assessment

Transient Dynamics[1] focuses on transient retrieval dynamics and energy landscape structure using a bipartite cavity approach, while the original paper emphasizes convergence properties (convergence time, attraction basins) using generating functional analysis. The methodological approaches and analytical focuses differ substantially.

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2. Semantically-correlated memories in a dense associative model

URL: View paper

Brief Assessment

Semantically Correlated Memories[3] focuses on introducing a novel associative memory model (CDAM) that integrates auto- and hetero-association with graph structures for continuous-valued patterns. It does not present dynamical analysis using generating functional analysis (GFA) or address the asymptotic dynamics of dense associative memory in the large-system limit.

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3. Bifurcation Analysis of Time-Delayed Non-Commensurate Caputo Fractional Bi-Directional Associative Memory Neural Networks Composed of Three Neurons

URL: View paper

Brief Assessment

Caputo Fractional BAM[7] focuses on bifurcation analysis of fractional-order bi-directional associative memory neural networks with time delays, not on dense associative memory or generating functional analysis methods.

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4. Saddle Hierarchy in Dense Associative Memory

URL: View paper

Brief Assessment

Saddle Hierarchy[11] focuses on stationary points and equilibrium properties of dense associative memory using replica method and statistical mechanics, not on dynamical properties or generating functional analysis. The candidate studies saddle-point equations for trained weights rather than convergence dynamics during retrieval.

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5. Theoretical framework for quantum associative memories

URL: View paper

Brief Assessment

Quantum Associative Framework[53] focuses on quantum associative memory using open quantum system dynamics, not classical dense associative memory or generating functional analysis for dynamical properties.

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6. Adaptive bidirectional associative memories

URL: View paper

Brief Assessment

Adaptive Bidirectional Memory[52] focuses on bidirectional associative memory (BAM) with two-layer networks and Hebbian learning, not on dense associative memory or generating functional analysis for dynamical properties in the large-system limit.

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7. Statistical neurodynamics of associative memory

URL: View paper

Brief Assessment

Statistical Neurodynamics[51] focuses on traditional Hopfield models with autocorrelation associative memory, not dense associative memory or modern Hopfield networks. The candidate does not address the specific architecture analyzed in the original paper.

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8. Nonlinear PDEs approach to statistical mechanics of dense associative memories

URL: View paper

Brief Assessment

Nonlinear PDEs Memory[54] focuses on developing analytical methods based on nonlinear partial differential equations to study dense associative memories, rather than using generating functional analysis for dynamical properties as in the original paper.

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9. Hierarchical associative memory

URL: View paper

Brief Assessment

Hierarchical Associative Memory[5] focuses on multi-layer architectures with feedback connections and energy functions for hierarchical data representation, not on dynamical analysis of dense associative memory using generating functional analysis.

10. Higher-Order Kuramoto Oscillator Network for Dense Associative Memory

URL: View paper

Brief Assessment

Higher-Order Kuramoto[28] focuses on oscillator networks with phase dynamics and higher-order coupling, not on the dynamical analysis of dense associative memory using generating functional analysis. The candidate studies synchronization in continuous-phase oscillator systems rather than the discrete-state recurrent networks analyzed in the original paper.

Contribution 2: Quantitative characterization of convergence properties

Description: The analysis provides explicit quantitative results on key convergence properties such as convergence time and the size of attraction basins. This enables a quantitative evaluation of the stability and storage capacity of dense associative memory, which is useful for model design.

This contribution was assessed against **10 related papers** from the literature. Papers with potential prior art are analyzed in detail with textual evidence; others receive brief assessments.

1. Long-term attraction in higher order neural networks

URL: View paper

Prior Art Analysis

Higher Order Attraction[61] demonstrates that prior work exists on quantitative convergence analysis in higher order neural networks. The candidate paper explicitly provides quantitative results on convergence time (upper bounds on convergence rate) and attraction basin sizes (attraction radius of size ρn) for higher order neural networks, predating the original paper's claims. Both papers analyze similar network architectures (higher order/dense associative memory) and provide explicit mathematical characterizations of these convergence properties.

Evidence

Evidence 1 - **Rationale**: Both papers provide explicit quantitative results on attraction basin sizes. The candidate explicitly quantifies attraction radius as ρn, while the original claims to provide 'explicit results on the size of attraction basins.' - **Original**: our analysis yields explicit results on convergence properties of memory retrieval, including convergence time and the size of attraction basins, thereby enabling quantitative evaluation of stability and storage capacity. - **Candidate**: our main result is that for any kappa(d)<d!2(d-1)/(2d)!, and 0< or =rho<1/2, a hebbian higher order neural network of order d with n neurons can store a random set of kappa(d)n(d)/log n fundamental memories such that almost all memories have an attraction radius of size rhon.

Evidence 2 - **Rationale**: Both papers provide quantitative characterizations of convergence time. The candidate explicitly upper bounds the convergence rate, while the original claims to enable 'quantitative evaluation of the convergence time.' - **Original**: we show results on convergence properties of memory retrieval, such as the convergence time and the size of the attraction basins. our analysis enables a quantitative evaluation of the convergence time and the storage capacity of dense associative memory, which is useful for model design. - **Candidate**: in addition we upper bound the convergence rate (number of iterations required to converge). this bound is asymptotically independent of n.

2. Capacity of the Hebbian-Hopfield network associative memory

URL: View paper

Brief Assessment

Hebbian Hopfield Capacity[56] focuses on static storage capacity analysis using replica theory, not dynamical convergence properties like convergence time and attraction basin evolution during retrieval.

3. Neuromodulation-inspired gated associative memory networks: extended memory retrieval and emergent multistability

URL: View paper

Brief Assessment

Neuromodulation Gated Memory[20] focuses on gated associative memory networks with neuromodulation-inspired mechanisms, not on quantitative convergence analysis of dense associative memory. The paper does not address convergence time or attraction basin sizes in the context claimed by the original contribution.

4. Trained recurrent neural networks develop phase-locked limit cycles in a working memory task

URL: View paper

Brief Assessment

Phase Locked Cycles[55] focuses on phase-coding dynamics in working memory tasks using trained RNNs with limit cycle attractors. It does not address convergence time or attraction basin analysis in dense associative memory networks.

5. Latent Structured Hopfield Network for Semantic Association and Retrieval

URL: View paper

Brief Assessment

Latent Structured Hopfield[62] focuses on episodic memory formation through autoencoder-based attractor dynamics, not on quantitative analysis of convergence time or attraction basin sizes in dense associative memory networks.

6. Effect of dilution in asymmetric recurrent neural networks

URL: View paper

Brief Assessment

Dilution Asymmetric Networks[60] studies diluted asymmetric recurrent networks with different structural properties, not dense associative memory models. The candidate focuses on dilution effects in asymmetric networks rather than the specific convergence analysis framework for dense associative memory.

7. Subspace Rotation Algorithm for Training Restricted Hopfield Network

URL: View paper

Brief Assessment

Subspace Rotation Training[59] focuses on training algorithms for Restricted Hopfield Networks using SVD-based methods, not on analyzing convergence time and attraction basin sizes in dense associative memory dynamics.

8. Convergence results in an associative memory model

URL: View paper

Brief Assessment

Convergence Associative Model[57] addresses convergence phenomena and attraction basin radius in a different associative memory model. The candidate's context is too limited to determine if it provides similar quantitative characterizations (convergence time, basin size) for the same dense associative memory framework analyzed in the original paper.

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9. Memory search using complex dynamics in a recurrent neural network model

URL: View paper

Brief Assessment

Memory Search Dynamics[63] focuses on complex dynamics in recurrent networks but does not provide explicit quantitative results on convergence time and attraction basin sizes for dense associative memory models.

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10. Quantitative Attractor Analysis of High-Capacity Kernel Logistic Regression Hopfield Networks

URL: View paper

Brief Assessment

Kernel Logistic Hopfield[58] focuses on kernel-based Hopfield networks with different dynamics and learning methods (kernel logistic/ridge regression), not the dense associative memory model analyzed in the original paper. The convergence analysis contexts differ fundamentally.

Contribution 3: Novel insight into robustness of modern Hopfield networks

Description: The authors demonstrate that in dense associative memory with higher-order interactions (n >= 3), the retrieval of a pattern does not act as additional noise to itself, unlike in the traditional Hopfield model. This structural property of modern networks makes the recall process more robust.

This contribution was assessed against **0 related papers** from the literature. Papers with potential prior art are analyzed in detail with textual evidence; others receive brief assessments.

Appendix: Text Similarity Detection

No high-similarity text segments were detected across any compared papers.

References

- [0] Dynamical properties of dense associative memory View paper
- [1] Transient dynamics of associative memory models View paper
- [2] Further analysis on dynamical properties of fractionalâ□□order biâ□□directional associative memory neural networks involving double delays View paper
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