

Evaluation and Architectural Analysis of the “Asta Find Papers” Knowledge Agent

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Abstract—The exponential growth of academic literature has made manual information retrieval increasingly inefficient and inaccessible. This report evaluates the performance and architectural design of “Asta Find Papers,” an agentic search system developed by the Allen Institute for AI (Ai2). Unlike traditional keyword-based search engines, Asta employs an Agentic Retrieval-Augmented Generation (RAG) workflow to synthesize scientific literature. I compare Asta against Google Scholar using complex, context-heavy queries (e.g., “cross-correlation algorithms for IMU synchronization”). The evaluation reveals that while Google Scholar optimizes for high recall, often retrieving irrelevant papers sharing lexical keywords, Asta achieves superior precision through semantic reasoning and relevance verification. Furthermore, this report analyzes the underlying architecture of Asta, identifies “Relevance Verification” as a crucial step, and details a Python-based reproduction of this mechanism to demonstrate its effectiveness in filtering search noise.

INTRODUCTION

The rapid growth of scientific literature presents significant challenges for researchers attempting to find and access relevant information. Traditional search engines, such as Google Scholar, rely primarily on lexical keyword matching to retrieve documents. While effective for navigational queries, such as finding a specific known paper, these systems struggle with information synthesis and comprehension. These limitations become apparent when users seek answers to complex questions rather than specific documents. In these scenarios, simple keywords often fail to capture the user’s research intent.

“Asta Find Papers” represents a shift toward agentic search. Instead of simply indexing documents, it functions as a research knowledge agent that plans queries, retrieves evidence from multiple sources, and verifies relevance using Large Language Models (LLMs).

This report presents a comprehensive analysis of the “Asta Find Papers” service. Section I evaluates its performance relative to Google Scholar. Section II examines its hybrid, AI-enabled retrieval architecture. Finally, Section III details the implementation of a custom relevance verifier agent, reproducing Asta’s core filtering logic to mitigate hallucination and search noise.

I. EVALUATION (ASTA FIND PAPERS VS. GOOGLE SCHOLAR)

A. Methodology

To evaluate the Asta Find Papers service relative to Google Scholar, I adopted a qualitative methodology centered on four core metrics:

- **Precision:** The proportion of retrieved results that are semantically relevant to the user’s specific domain.
- **Synthesis Quality:** The system’s ability to extract and integrate answers rather than merely listing bibliographic links.
- **Transparency:** The traceability of generated claims back to their original primary sources.
- **Context Awareness:** The extent to which the system captures user intent beyond simple keyword matching.

I tested two distinct classes of queries representing common research workflows:

- 1) **Survey Query:** “What are the latest mitigation strategies for object hallucination in LVLMs?” (Goal: Discovery and summarization).
- 2) **Context-Constraint Query:** “How does cross-correlation synchronize IMU and camera data for liveness detection?” (Goal: Focused technical explanation and semantic filtering).

B. Performance of Google Scholar (The Baseline)

I first evaluated the baseline system, Google Scholar, using the survey query regarding object hallucination in Large Vision-Language Models (LVLMs) (See Fig. 1).

Google Scholar demonstrated high recall and low latency, successfully retrieving a raw list of recent papers in milliseconds. However, the lack of synthesis capabilities requires manual verification, where the user must individually click and vet papers to identify specific strategies hidden within the PDF content. While the platform maintains high transparency by providing direct links, it exhibits limited context awareness, often presenting redundant titles without grouping or ranking by semantic relevance.

I next evaluated Google Scholar using the context-constraint query regarding IMU/camera synchronization for liveness detection (See Fig. 2).

What are the latest mitigation strategies for object hallucination in LVLMs



About 1,290 results (0.09 sec)

Analyzing and mitigating object hallucination in large vision-language models
Y Zhou, C Cui, J Yoon, L Zhang, Z Deng, C Finn... - arXiv preprint arXiv ..., 2023 - arxiv.org

... We evaluate LURE on six open-source LVLMs and found it outperforms the previous best approach in both general object hallucination evaluation metrics, GPT, and human evaluations...

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Mitigating object hallucinations in large vision-language models through visual contrastive decoding

S Leng, H Zhang, G Chen, X Li, S Lu... - Proceedings of the ..., 2024 - openaccess.thecvf.com

... beyond the scope of object hallucination mitigation. To sum up, ... uncertainty on object hallucinations in LVLMs, particularly ... that can effectively mitigate object hallucinations in LVLMs. It ...

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Analyzing and Mitigating Object Hallucination: A Training Bias Perspective

Y Li, K Zhou, WX Zhao, L Fang, JR Wen - arXiv preprint arXiv:2508.04567, 2025 - arxiv.org

... Surprisingly, we observe that LVLMs may even hallucinate on images they ... an object in a training image is masked out. LVLMs still answer "Yes" to a question asking whether that object ...

☆ Save 99 Cite Cited by 2 Related articles All 2 versions ☺

Hallucination of multimodal large language models: A survey

Z Bai, P Wang, T Xiao, T He, Z Han, Z Zhang... - arXiv preprint arXiv ..., 2024 - arxiv.org

... Then, we review and discuss recent works tailored to mitigate the problem of hallucination ... [76], a short survey on the hallucination problem of LVLMs. However, our survey distinguishes ...

☆ Save 99 Cite Cited by 385 Related articles All 3 versions ☺

A survey on hallucination in large vision-language models

H Liu, W Xue, Y Chen, D Chen, X Zhao, K Wang... - arXiv preprint arXiv ..., 2024 - arxiv.org

... existing methods for mitigating hallucinations. The ... hallucinations in LVLMs, focusing on the training data and model characteristics. Our analysis indicates that hallucinations in LVLMs ...

☆ Save 99 Cite Cited by 407 Related articles All 3 versions ☺

Fig. 1. Google Scholar response to Query 1

The baseline system failed significantly due to lexical noise. Scholar's keyword-based retrieval algorithm prioritized terms like "cross-correlation" and "IMU" without understanding the biometric context of "liveness detection." Consequently, the search returned irrelevant results, such as papers on synchronizing dance movements to music or steering vehicles. This confirms that while Google Scholar excels at lexical matching, it struggles to capture complex research intent when domain-specific constraints are applied.

C. Performance of Asta (The Agent)

Using the same queries, I evaluated the agentic system, "Asta Find Papers."

For the query regarding LVLMs (See Fig. 3), Asta functioned as an intelligent filter rather than a simple indexer. While the process took approximately 33 seconds, the system achieved excellent precision. It did not just list papers but synthesized the content to explicitly name mitigation methods found within the literature, such as LURE, Visual Contrastive Decoding (VCD), and LRV-Instruction. Furthermore, Asta provided a relevance score for each result, justifying its selection with specific evidence snippets. This approach reduces the manual burden of reading while maintaining transparency through the use of direct citations.

For the query regarding how cross-correlation synchronizes IMU and camera data for liveness detection (See Fig. 4), the difference in architecture became most apparent. Asta

How does cross-correlation synchronize IMU and camera data for liveness de



About 573 results (0.13 sec)

Automatic synchronization of wearable sensors and video-cameras for ground truth annotation—A practical approach

T Plotz, C Chen, NY Hammerla... - 2012 16th international ..., 2012 - ieeexplore.ieee.org

... The synchronization method automatically detects these marker sequences in both video and accelerometer data and calculates normalized cross-correlation ... units (IMU) are used to ...

☆ Save 99 Cite Cited by 69 Related articles All 7 versions

[PDF] Synchronization of an inertial measurement unit and standalone camera system based on attitude and optical flow data

LA Arnold - 2012 - scholarspace.manoa.hawaii.edu

... are based on cross-correlation, the term "matched filter" is used throughout this paper to distinguish the template matching from the overall goal of correlating the IMU and camera data ...

☆ Save 99 Cite Cited by 2 Related articles All 2 versions

SyncWISE: Window induced shift estimation for synchronization of video and accelerometry from wearable sensors

YC Zhang, S Zhang, M Liu, E Daly, S Battalio... - Proceedings of the ..., 2020 - dl.acm.org

... well-matched to our goal since crosscorrelation (used in our proposed algorithm) ... IMU positions, we find that right arm acceleration is most informative in synchronizing with the camera ...

☆ Save 99 Cite Cited by 18 Related articles All 8 versions ☺

Dance Movement and Sound Cross-Correlation; Synthesis Parameters on the Micro and Meso Musical Time Scales

A Koruga, K Tahiroğlu - Proceedings of the 19th International Audio ..., 2024 - dl.acm.org

... in both camera and IMU systems. Likewise, post-processing ... of all IMU data (60Hz), as well as 32 sample cross-correlation ... possibility of highlighting synchronized movements within the ...

☆ Save 99 Cite Related articles All 4 versions

Automated synchronization of driving data using vibration and steering events

L Fridman, DE Brown, W Angell, I Abdić... - Pattern Recognition ..., 2016 - Elsevier

... front camera and scene vibration for the face and dash cameras in ... The IMU sensor was on the data collection device that was ... show sensor traces and cross correlation functions for a ...

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Fig. 2. Google Scholar response to Query 2

took over seven minutes to process the query but correctly identified the semantic mismatch in the available literature. Unlike Google Scholar, which forced irrelevant results, Asta correctly reported that it could not find papers specifically linking cross-correlation synchronization to liveness detection. It provided a negative result warning, accurately distinguishing between the presence of keywords and the presence of the specific requested concept. This demonstrates a high degree of active verification, preventing the user from wasting time on semantically irrelevant papers.

D. Comparative Analysis and Summary

The structural differences between the two systems are summarized in Table I.

While Google Scholar remains the better tool for navigational queries (finding a known paper), Asta demonstrates a clear advantage for informational queries where synthesis and noise reduction are critical. Asta effectively bridges the gap between search and knowledge acquisition by extracting specific information that traditional engines leave buried in PDFs. The trade-off for this intelligence is latency, but the computational time is negligible compared to the human hours saved in manual literature review.

U What are the latest mitigation strategies for object hallucination in LVLMs

Researched for 33 seconds View steps ▾

I found 73 papers that look like perfect matches and 2 others.

This is what I searched for:

- Papers discussing: *mitigation strategies for object hallucination in Large Vision-Language Models (LVLMs)*.
- Judged by the following relevance criteria:
 - Object Hallucination Mitigation in LVLMs*: The paper directly addresses methods, techniques, or strategies aimed at reducing or eliminating object hallucination (the incorrect or unsupported identification of objects) in Large Vision-Language Models (LVLMs). This criterion focuses on papers that explicitly target the problem of object hallucination within the context of LVLMs.
 - Large Vision-Language Models (LVLMs)*: The paper discusses Large Vision-Language Models (LVLMs), which are models that process and integrate both visual and textual information. The paper should describe the architecture, training, or application of such models.
 - Mitigation Strategies*: The paper proposes or evaluates specific strategies, techniques, or methods designed to mitigate (reduce or eliminate) a problem. The paper should detail the approach and ideally provide empirical evidence of its effectiveness.

Between relevant papers, most-recent papers were prioritized due to explicit request.

75 Papers

A Survey on Hallucination in Large Vision-Language Models ⓘ

Hanchao Liu Wenyuan Xue Yifei Chen +5 Authors Wei Peng • arXiv.org • 2024

Perfectly Relevant: This survey paper is perfectly relevant as it focuses on hallucination mitigation in LVLMs, discussing symptoms, benchmarks, causes, and mitigation methods. It also covers LVLMs architectures and training, and proposes mitigation strategies such as refining visual representations and improving multi-modal alignment.

Object Hallucination Mitigation in LVLMs Large Vision-Language Models (LVLMs) Show Evidence ▾

↳ Cited by 235 ↳ Copy BibTeX

Mitigating Object Hallucinations in Large Vision-Language Models through Visual Contrastive Decoding ⓘ

Sicong Leng Hang Zhang Guanzheng Chen +3 Authors Li Bing

Computer Vision and Pattern Recognition • 2023

Perfectly Relevant: The paper introduces Visual Contrastive Decoding (VCD) to mitigate object hallucination in LVLMs. VCD contrasts output distributions from original and distorted visual inputs. The paper focuses on LVLMs and details a training-free method to reduce object hallucination.

Object Hallucination Mitigation in LVLMs Large Vision-Language Models (LVLMs) Show Evidence ▾

↳ Cited by 412 ↳ Copy BibTeX

Mitigating Hallucination in Large Multi-Modal Models via Robust Instruction Tuning ⓘ

Fig. 3. Asta Find Papers response to Query 1

U How does cross-correlation synchronize IMU and camera data for liveness detection?

Researched for 7m 16s View steps ▾

While I didn't find a perfect match, I did find 8 relevant ones and 60 others.

This is what I searched for:

- Papers discussing: *cross-correlation synchronization of IMU and camera data for liveness detection*.
- Judged by the following relevance criteria:
 - Cross-correlation Synchronization*: The paper discusses methods for synchronizing data streams using cross-correlation techniques. This should be a core component of the paper.
 - IMU and Camera Data*: The paper specifically addresses the synchronization of data from Inertial Measurement Units (IMUs) and cameras. The paper should describe the use of both IMU and camera data.
 - Liveness Detection Application*: The synchronized IMU and camera data is used for liveness detection. The paper should describe how the synchronized data is applied to determine if a subject is alive and present, or if the data is from a spoofing attempt.

You can either refine your query or start a new one.

68 Papers

MoVi: A large multi-purpose human motion and video dataset ⓘ

S. Ghorbani Kimia Mahdaviani A. Thaler +3 Authors N. Troje • PLoS ONE • 2020

Relevant: The paper uses cross-correlation to synchronize IMU and MoCap data, and because the MoCap system is synchronized with video cameras, the paper obtains synchronized IMU and video data. The synchronized data is not used for liveness detection.

Cross-correlation Synchronization IMU and Camera Data Liveness-Detection Application Show Evidence ▾

↳ Cited by 89 ↳ Copy BibTeX

Data-set for Event-based Optical Flow Evaluation in Robotics Applications ⓘ

M. Khairallah Fabien Bonardi D. Roussel S. Bouchafa • VISIGRAPP • 2021

Relevant: The paper uses cross-correlation to synchronize IMU and camera data. It calibrates the spatio-temporal relationship between IMU and camera using cross-correlation between IMU rotational velocity and event frequency. However, it does not discuss liveness detection.

Cross-correlation Synchronization IMU and Camera Data Liveness-Detection Application Show Evidence ▾

↳ Cited by 2 ↳ Copy BibTeX

PERSIST: A Multimodal Dataset for the Prediction of Perceived Exertion during Resistance Training ⓘ

Justin Amadeus Albert Arne Herdick C. M. Brahm +1 Authors B. Arrich • International Conference on Data Technologies and Applications • 2022

Relevant: The paper uses cross-correlation to synchronize IMU and camera data from an Azure Kinect. The synchronized data is used to predict perceived exertion during resistance training, not for liveness detection.

Cross-correlation Synchronization IMU and Camera Data Liveness-Detection Application Show Evidence ▾

Fig. 4. Asta Find Papers response to Query 2

TABLE I
COMPARISON OF SEARCH ATTRIBUTES

Feature	Google Scholar	Asta (Agentic)
Search Logic	Lexical (Keyword)	Semantic + Reasoning
Precision	Low (Noisy)	High (Context-Aware)
Output	List of Links	Synthesized Answer
User Effort	High (Manual Reading)	Low (Auto-Extraction)
Failure Mode	Misinterpretation of Intent	Hallucination Risk
Latency	Milliseconds	Seconds to Minutes
User Exp.	Retrieval-Centric	Answer-Centric

II. ARCHITECTURAL ANALYSIS

A. High-Level Architecture: The Agentic Workflow

Asta Find Papers operates not just as a search indexer, but as an autonomous knowledge agent. Unlike Google Scholar, which relies on static retrieval, Asta plans and executes a multi-step research workflow. It mimics the cognitive process of a human researcher: iteratively searching, scanning abstracts, verifying citations, discarding irrelevant results, and refining the search strategy based on intermediate findings.

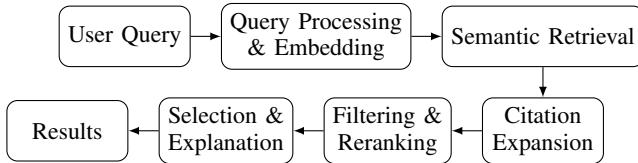


Fig. 5. High-level workflow of Asta Find Papers.

B. The Step-by-Step Workflow From Query to Result

The Asta Paper Finder generally follows the workflow of a standard LLM-driven retrieval system. The steps described below closely align with the methodology described in [1]:

- 1) **Query Processing & Embedding:** The system translates a user's natural language request into embedding vectors, capturing semantic meaning, key concepts, and metadata constraints.

Challenge: Users often use ambiguous, colloquial terms or vague descriptions, leading to a vocabulary mismatch between the query and the academic terminology.

Solution: Asta utilizes an LLM to analyze the raw query, decomposing it into core scientific concepts and specific metadata constraints before generating high-quality embeddings.

- 2) **Semantic Retrieval:** The system identifies a candidate set of papers from a database of hundreds of millions using semantic similarity measures (e.g., Semantic Scholar).

Challenge: Vector search at this scale is computationally intensive. Furthermore, purely semantic searches can yield papers that use similar language but discuss entirely different topics.

Solution: Asta employs Approximate Nearest Neighbor (ANN) algorithms for speed, running these in parallel with standard keyword-based API calls to ensure exact matches are not lost by the vector model.

- 3) **Citation Expansion:** For the top retrieved papers, the system explores citation graphs to discover relevant work that may not match the initial query terms directly.

Challenge: Pure semantic search is limited by the initial vocabulary. Important foundational papers or novel applications may use different terminology. Additionally, citation graphs are noisy, and not all cited papers are relevant to the specific claim being investigated.

Solution: Asta performs a bidirectional traversal of the citation graph starting from high-confidence nodes. It

applies relevance-aware filtering to retain only those citations that match the user's research intent.

- 4) **Filtering & Reranking:** The system narrows the expanded pool to the most pertinent results using LLM-based relevance judgment.

Challenge: A paper might be semantically relevant but outdated, or highly cited but irrelevant to the specific nuances of the user's query.

Solution: An LLM-based reranker evaluates metadata, abstracts, and extracted passages. It assigns a relevance score by combining semantic similarity with other signals, while applying metadata filters.

- 5) **Selection & Explanation:** The system presents the final results to the user with justifications, evidence snippets, and bibliographic data.

Challenge: Standard search engines provide context-free snippets that force users to read the full text. Additionally, LLM-generated summaries risk hallucination if not strictly grounded.

Solution: Asta utilizes Retrieval-Augmented Generation (RAG) to ensure all summaries are traceable to specific passages. The LLM acts as a relevance judge, outputting both the decision logic and the supporting evidence.

III. IMPLEMENTATION (THE KNOWLEDGE AGENT)

One key task in building Asta is relevance verification via filtering and reranking. This step transforms a system from a passive search engine into an active knowledge agent by having an LLM explicitly evaluate whether each retrieved paper truly addresses the user's intent. Historically, this task was performed by scoring document pairs based on text similarity. However, these models lack logical reasoning capabilities, and the current state-of-the-art has shifted toward LLM-as-a-Judge architectures, which allow the system to not only score a paper but to justify that score with extracted evidence.

To validate this architectural finding, I developed a Python-based relevance verifier that reproduces Asta's core filtering logic.¹

A. System Design

The implementation integrates the **Semantic Scholar API** for broad retrieval and **Google Gemini 2.5 Flash-Lite** as the reasoning engine. The agent operates in a three-stage workflow:

- 1) **Broad Retrieval:** The agent fetches a candidate pool of raw papers ($N = 10$) using standard keyword search. This simulates the high-recall/low-precision output of traditional engines.
- 2) **Agentic Verification Loop:** Instead of displaying these links immediately, the agent enters a verification loop. It iterates through each candidate, passing the abstract and the user's query to the LLM with a strict prompt to determine relevance and provide reasoning and evidence.

¹Code available at: <https://github.com/amey-gupt/Scholar-Verifier-Agent>

- 3) **Evidence Extraction:** The system applies a hard filter (Score > 5) and renders the remaining papers in a structured table, highlighting the specific evidence snippet that justified the selection.

B. Experimental Results

Initially, I tested the agent using the second query from Section I; however, Semantic Scholar returned zero papers because the query was too specific. I therefore evaluated the system using the technical query: “*IMU camera synchronization cross-correlation*.”

The broad retrieval stage returned 9 raw candidate papers. As shown in Fig. 6, the agent successfully filtered search noise, reducing the pool to 4 verified papers. The LLM correctly discarded papers that merely mentioned “cross-correlation” in unrelated contexts while retaining papers that explicitly discussed synchronization algorithms.

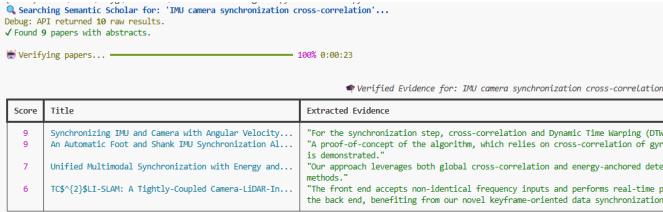


Fig. 6. Relevance Verification Implementation Result. The agent filtered 9 raw papers down to 4, extracting the specific evidence sentence for each match.

This proof-of-concept confirms that integrating LLMs as active judges significantly increases search precision.

C. Limitations and Future Improvements

To further approximate the full Asta system and improve the current implementation, a key next step would be to add a query processing and decomposition module. Rather than relying on the user’s raw input, the agent could reformulate the query, decompose it into sub-questions, and better capture user intent before querying Semantic Scholar. This would enable the retrieval of a more diverse and representative candidate pool, further improving relevance verification.

CONCLUSION

This report evaluated Asta Find Papers and demonstrated its superiority over traditional search engines for complex knowledge discovery tasks. By shifting from semantic retrieval to agentic reasoning, Asta solves the information overload problem, filtering noise and synthesizing answers rather than just listing links. My reproduction of the Relevance Verification step confirms that integrating LLMs as active judges in the search loop is the key architectural shift enabling this performance. As scientific literature continues to grow, such agentic systems will become indispensable tools for researchers.

REFERENCES

- [1] “Introducing Ai2 Paper Finder,” Allen Institute for AI Blog. [Online]. Available: <https://allenai.org/blog/paper-finder>.