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Agentic AI-based mission planning in unmanned aerial vehicle fleets: a systematic review protocol

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 1 October 2026 and was last updated on 1 October 2026.

INTRODUCTION

Review question / Objective This review addresses three research questions: (RQ1) What traditional computational AI techniques exist to support UAV mission planning? (RQ2) How has Agentic AI advanced UAV mission planning, and what open challenges limit its deployment and assurance in safety-critical contexts? (RQ3) How can formal verification be used to provide safety guarantees for Agentic AI-synthesised mission plans?.

Rationale Agentic AI systems, built on large language models and vision-language models, are increasingly used for UAV mission planning due to their autonomous reasoning and goal decomposition capabilities. However, their probabilistic and non-deterministic nature raises concerns about trustworthiness in safety-critical applications. Existing reviews have focused mainly on traditional AI approaches to UAV path planning, with limited attention to Agentic AI, and no established evidence that prior reviews have

addressed the need for rigorous validation of Agentic AI-generated mission plans. This review addresses that gap by systematically surveying Agentic AI applications in UAV fleet mission planning and examining the extent to which formal verification methods have been integrated to support trustworthy, safety-assured planning.

Condition being studied The topic is UAV (unmanned aerial vehicle) mission and path planning, with particular focus on the use of Agentic AI (autonomous agents built on large generative AI models, including LLMs and VLMs) for route planning, task assignment, and multi-UAV coordination under dynamic and uncertain operating conditions. The review also examines the extent of formal safety assurance method integration in the realms of Trustworthy AI for validating AI-synthesised mission plans in safety-critical UAV operations.

METHODS

Search strategy Three databases were searched: IEEE Xplore, Scopus, and ACM Digital Library, covering publications from 2022 to 2026. Search terms combined concepts of ("Agentic AI" OR "Artificial Intelligence" OR "AI" OR "Generative AI") AND ("mission planning" OR "path planning" OR "trajectory planning") AND ("Unmanned Aerial Vehicle" OR "Drone" OR "UAV"), excluding review/survey articles via NOT operators where supported. The ACM Digital Library search was limited to basic search functionality, as advanced search required a premium subscription. A supplementary snowball search of reference lists and a basic Google Scholar search were used to identify additional Agentic AI studies, given the limited volume of directly retrieved Agentic AI literature.

Participant or population Not applicable in the traditional sense (no human participants). The unit of analysis is peer-reviewed journal and conference articles reporting AI-based (including Agentic AI-based) UAV mission or path planning techniques, published 2022–2026.

Intervention The "intervention" of interest is the AI technique applied for UAV mission/path planning, spanning six traditional computational categories (sampling-based, search-based, metaheuristic, learning-based, mathematical optimisation, hybrid) and in particular, Agentic AI approaches (LLM/VLM-based autonomous agents), their safety implications in autonomous UAV missions. Finally, we evaluated the frameworks for providing safety assurances of Agentic AI-synthesised mission plans given inherent limitations such as goal drift, hallucination, and bias. This work focuses mainly on safety as a dimension of Trustworthy AI.

Comparator Comparative assessment is made across the identified AI technique categories (traditional vs. Agentic AI) against criteria including adaptability, scalability, multi-UAV coordination capability, and formal verifiability, rather than a single reference intervention.

Study designs to be included Peer-reviewed journal articles and conference papers presenting an AI technique implementation for UAV path/mission planning; published 2022 or later; full text in English.

Eligibility criteria Inclusion: peer-reviewed journal/conference article; AI, Agentic AI, UAV, and mission planning as core topics; published 2022 or later; full text in English; published in a reputable journal;

methodology and findings clearly accessible. Exclusion: reviews/surveys rather than technique implementations; off-topic studies; theses, unpublished reports, editorials, blogs, white papers; no clear methodology; duplicate/insignificant-improvement studies; no DOI; drafts under review. Additional criteria (citation count, journal impact factor, or CiteScore) were applied where database representation was disproportionate toward traditional techniques.

Information sources IEEE Xplore, Scopus, ACM Digital Library (database searches); supplementary citation/snowball searching of reference lists of included Agentic AI studies; basic Google Scholar search for additional Agentic AI articles.

Main outcome(s) For each included study: AI technique/algorithm used, mission planning objectives addressed (e.g. optimal path, time efficiency, collision avoidance, minimised risk), constraints considered (e.g. flight altitude, UAV kinematics, energy, obstacles), use of formal verification methods, UAV configuration (single/multi), spatial and temporal planning domain, experiment type (simulation/real-world), and application domain.

Additional outcome(s) Cross-technique comparison across adaptability (online/real-time capability, dynamic obstacle handling, unknown-environment operation), scalability, multi-UAV coordination support, and verifiability (extent of formal correctness proof).

Data management Screening was conducted by the first author against predefined inclusion/exclusion criteria established prior to screening. The remaining authors independently reviewed and vetted the screening process, with ambiguous cases discussed and resolved by consensus during full-text review. Study characteristics were extracted into structured tables, including article details, methodology, specific AI technique, planning domain, objectives, constraints, experiment type, and dimensionality. Raw data and screening records are maintained in a public GitHub repository.

Quality assessment / Risk of bias analysis No formal risk-of-bias assessment tool (e.g. ROBIS, QUADAS) was applied, as included studies are technical AI-methods papers rather than clinical or intervention trials. Study quality was instead addressed through additional selection criteria: citation count and journal impact factor or CiteScore were checked for studies with low citation counts to confirm indexing in reputable

databases (IEEE Xplore, ACM, Scopus) or acceptable bibliometric standing for conference proceedings.

Strategy of data synthesis A narrative synthesis approach was used. Included studies were grouped into six traditional computational AI technique categories (sampling-based, search-based, metaheuristic, learning-based, mathematical optimisation, hybrid) plus a separate Agentic AI category. Findings were tabulated (characteristics, objectives, constraints) and visualised (distribution by year, technique, application domain, and constraint type) to answer RQ1–RQ3. No meta-analysis of quantitative effect sizes was performed, as included studies are not comparable on a common outcome metric.

Subgroup analysis Comparative analysis was conducted between the six traditional AI technique categories and the Agentic AI category, including online/real-time capability, dynamic obstacle handling, unknown-environment operation, scalability, multi-UAV coordination, and verifiability.

Sensitivity analysis Not applicable. This review uses narrative synthesis rather than meta-analysis, so no statistical robustness checks (e.g. model sensitivity, exclusion of high-risk-of-bias studies) apply.

Language restriction English only.

Country(ies) involved New Zealand.

Other relevant information This protocol is being registered retrospectively, after completion of the review and manuscript preparation. Study screening, data extraction, and synthesis were conducted prior to registration. The review methodology, eligibility criteria, and search strategy described in this protocol reflect the methods as actually carried out transparently. No methodological decisions were altered after study findings were known.

Keywords Unmanned Aerial Vehicle; Agentic AI; UAV mission planning; path planning; trustworthy AI; formal verification; large language models.

Dissemination plans Findings will be disseminated via peer-reviewed journal publication (currently submitted). Review data, including the PRISMA screening records, are publicly available in a GitHub repository, with the link to be updated upon journal acceptance.

Contributions of each author

Author 1 - John Ogbonoko - Systematic review of literature, data collection and analysis, drafted the initial manuscript.

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