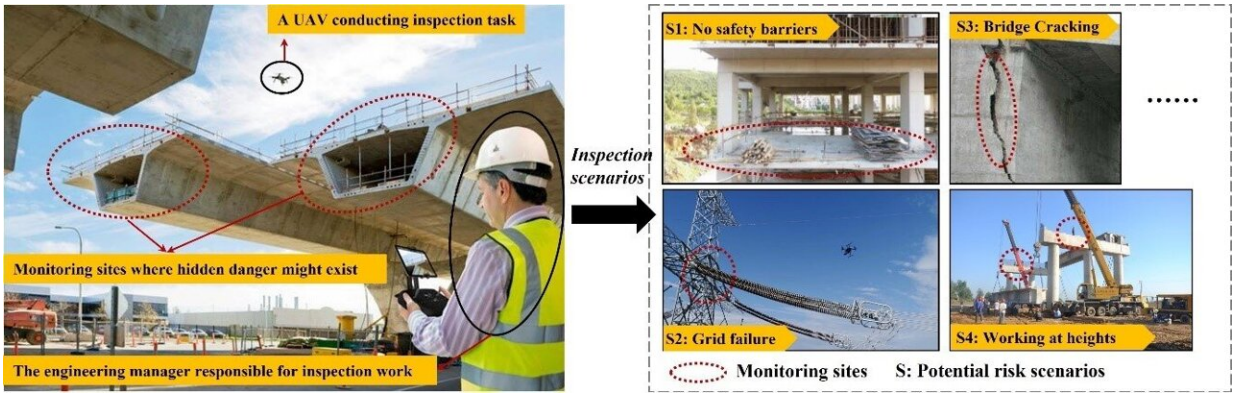
Innovation in the skies: New approach to unmanned aerial vehicle-driven engineering inspections

March 6 2024



The UAV-based inspection approach has great advantages for performing inspection tasks in a complex and high-risk construction environment in order to continuously screen out potential hidden dangers. Credit: Lu Zhen, Zhiyuan Yang, Gilbert Laporte, Wen Yi, Tianyi Fan

In a study published in *Engineering*, a collaborative team of researchers from Shanghai University and international experts have unveiled a cutting-edge approach to optimizing unmanned aerial vehicle (UAV) inspection routes and schedules for engineering projects.

The research, led by Lu Zhen, Zhiyuan Yang, Gilbert Laporte, Wen Yi, and Tianyi Fan, introduces an innovative mixed-integer linear

programming (MILP) model combined with a variable neighborhood search (VNS) algorithm, constructing a new approach in the field of engineering management.

The rapid development and adoption of UAV technology have opened new horizons for various industries, particularly in engineering, where the need for efficient, safe, and cost-effective inspection methods is ever-present. Traditional inspection techniques, often manual and fraught with risks, fall short of addressing the complexities and dangers associated with large-scale engineering projects.

The team's research provides a sophisticated solution to this challenge, leveraging the agility and precision of UAVs to conduct inspections in a fraction of the time and with significantly reduced risk to human inspectors.

The heart of this innovation lies in the meticulous design of the MILP model and VNS algorithm, which together navigate the intricate constraints of UAV operations, such as limited battery capacity and regulatory no-fly zones. This advanced optimization framework not only ensures comprehensive coverage of inspection areas but also adapts dynamically to on-site conditions, maximizing efficiency and safety.

Highlighting the practical application of their research, the team conducted a case study on the Shiziyang Bridge project. The results demonstrated the model's remarkable capability to streamline UAV routing and scheduling, identifying potential risks and structural issues within a short time. This real-world application underscores the model's potential to transform engineering management practices, offering a glimpse into the future of engineering inspections.

As the global engineering industry continues to grow and evolve, the demand for innovative solutions like UAV-based inspections will only

increase. This research not only meets this demand but also offers a scalable, adaptable, and robust framework for leveraging technology to enhance safety and efficiency.

The full research article, "Unmanned Aerial Vehicle Inspection Routing and Scheduling for Engineering Management" provides an in-depth exploration of the methodology, experiments, and broader implications of this breakthrough. Available in *Engineering*, it serves as a valuable resource for engineers, project managers, and policymakers seeking to harness the power of UAV technology for safer, more efficient engineering practices.

This study marks a significant milestone in the field of engineering management, offering practical, innovative solutions that promise to revolutionize engineering inspections worldwide. With its blend of academic rigor and real-world applicability, the research exemplifies the potential of interdisciplinary collaboration to address complex challenges, driving progress and innovation in the engineering industry and beyond.

More information: Lu Zhen et al, Unmanned Aerial Vehicle Inspection Routing and Scheduling for Engineering Management, *Engineering* (2024). DOI: 10.1016/j.eng.2023.10.014

Provided by Engineering