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Super-Resolution Reconstruction of Commercial Aircraft Runway Images Based on Omniscient Video Super-Resolution Method

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Abstract

This study focuses on the application of AI in visual navigation during the landing phase of an aircraft, particularly in challenging conditions such as low visibility and night lighting. During the aircraft landing process, the onboard camera's image resolution is reduced due to low visibility and night lighting conditions. This study selects runway simulation images under different airport and weather conditions, such as sunshine, low visibility, and night, to create a super-resolution reconstructed runway dataset containing dozens of runways and a total of 10,000 images. The global Omniscient Video Super-Resolution method is utilized, combined with the hidden state of the front and rear frames, to train and obtain a model applicable to the super-resolution reconstruction of runway images. This innovative model effectively improves the resolution of runway images during aircraft landing.

Introduction

With AI rapidly advancing, its applications across fields are deepening. In aircraft landing visual navigation, AI shows huge promise. However, during landing, issues like low visibility and insufficient lighting lead to low-resolution (LR) images from onboard cameras. Using these LR images poses challenges for precise aircraft positioning during landing. Hence, this study focuses on reconstructing these LR images using super-resolution (SR) techniques to obtain high-resolution (HR) runway images, allowing for precise identification and segmentation of the landing runway. We employ a global SR approach[1], integrating past and future hidden states, to enhance commercial aircraft perception of runways in typical landing conditions, potentially improving visual landing navigation control accuracy and reliability.

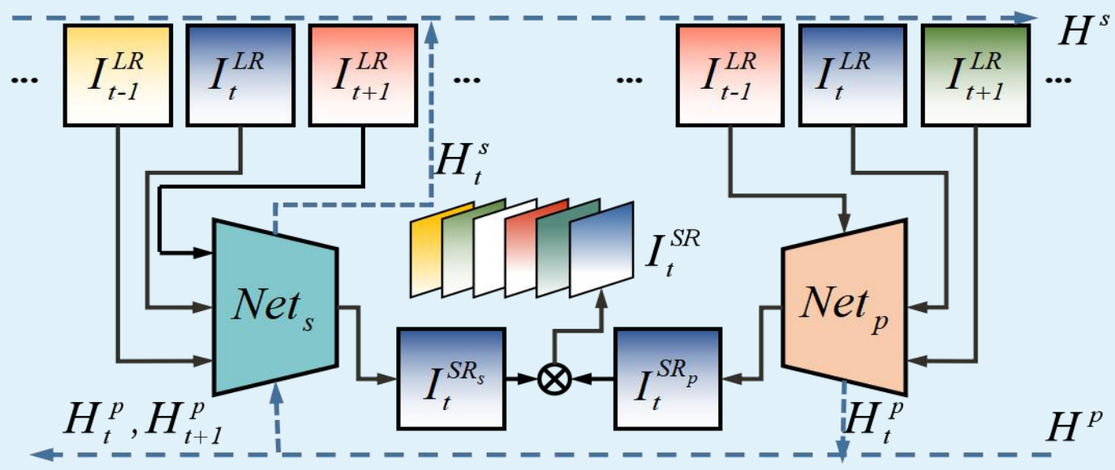
Experimental Results and Discussion

(a)original image (b)truth

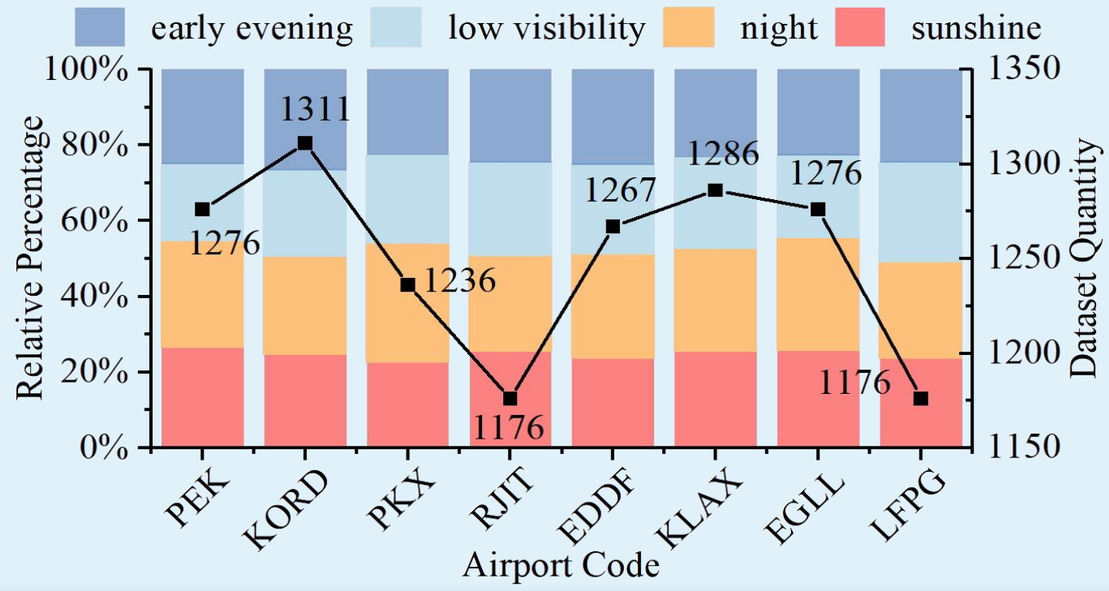
(c)low resolution images (d)super-resolution results

Proposed Methvod

- **network of Omniscient Video Super-Resolution**



- **Distribution of airport runway types included in the dataset and different environmental conditions in each runway**



- **Super-Resolution Model Development**

We have successfully developed a super-resolution model tailored for landing scenarios.

- **Testing Under Diverse Lighting Conditions**

The super-resolution model has been tested under various lighting conditions, including sunlight, low visibility, early evening, and night.

- **High Performance Metrics**

The model achieves a Peak Signal-to-Noise Ratio (PSNR) of over 50.

Conclusion

This study addresses the reconstruction of low-resolution images captured by onboard cameras during the aircraft landing phase. Employing a global super-resolution method, it effectively reconstructs images by combining the hidden states of preceding and succeeding frames through end-to-end mapping. Training and testing were conducted on a dataset constructed using the X-plane flight simulator, with results demonstrating satisfactory performance under various weather conditions. This method lays the groundwork for improving the accuracy and reliability of landing navigation control information for commercial aircraft.