



Summary

An imaging method providing atmospheric turbulence compensation includes capturing a subject image pair. Data corresponding to the captured subject image pair is loaded into memory associated with a parallel processing device. A 2-D Fast Fourier Transform is performed on the stored image data and the transformed image data is stored. An optical transfer function is developed for the transformed image data. The optical transfer function is inverted and applied to the transformed image data to generate corrected image spectrum data that is compensated for atmospheric aberrations. An Inverse Fast Fourier Transform is applied to the corrected image spectrum data to produce corrected image data. The corrected image data is stored.

Applications

- This It would be beneficial to both significantly modify the traditional atmospheric turbulence compensation methodology and also use a general-purpose parallel-processing device such as a field-programmable gated array to achieve real-time processing speeds. Utilizing both steps would enable a system to achieve real-time processing in a practical and scalable manner.
- This In the past, due to limitations of processor speed and some computational inefficiencies inherent in the majority of traditional post-processing atmospheric turbulence compensation approaches, this direct methodology illustrated by equation (16) was considered from a practical point of view to be much slower than the iterative Fourier transform-based approach described in steps 1 through 12 above. What is needed is a new methodology that overcomes these inefficiencies and provides for a software-dominant approach for atmospheric turbulence compensation that can be accomplished in real-time.

Advantages

- The method of the present invention uses image pairs captured simultaneously, so rapidly-changing backgrounds are not an issue. By using a modified correlation-based technique, many of the iterative 2-D FFT steps can be eliminated, reducing computational requirements. By taking advantage of processes that can be run in parallel and adapting error minimization to look-up tables, the computational processes can be further streamlined.

The Technology

An imaging method providing atmospheric turbulence compensation, comprising: capturing a subject image pair; loading data corresponding to the captured subject image pair into memory associated with a parallel processing device; performing a 2-D Fast Fourier Transform on the stored image data and storing the transformed image data; developing an optical transfer function estimate from the transformed image data and a suitable error metric; applying the optical transfer function estimate to generate a Wiener filter that implements an inverse optical transfer function; using the Wiener filter and the transformed image data to estimate an atmospheric turbulence compensated image spectrum; correcting the transformed image data based on the atmospheric turbulence compensated image spectrum, to produce corrected image spectrum data; applying an inverse 2-D Fast Fourier Transform to the corrected image spectrum data to produce transformed corrected data; and storing the transformed corrected data.

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