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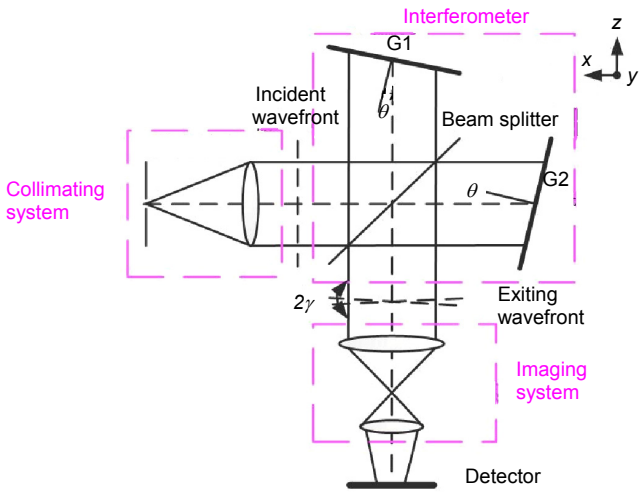
Interferogram correction of spatial heterodyne spectrometer

Wenli Zhang[1], Fengchun Tian[1]*, Zhenzhen Zhao[2], Li Zhang[1], Simon X. Yang[3] and An Song[1]

[1]Chongqing University, College of Communication Engineering, Chongqing 400044, China;
[2]Henan University of Economics and Law, College of Computer and Information Engineering, Zhengzhou 450000, China;
[3] School of Engineering, University of Guelph, Ontario N1G 2W1, Canada



Structure of SHS system.

Abstract: Spatial heterodyne spectroscopy (SHS) is a new spectral analysis technique for super-spectral resolution which is developed rapidly and used widely. At present, common applications include atmospheric microelement detection, atmospheric water vapor detection, laboratory astrophysics observation and other weak target identification. However, in practical applications, there are distortions of the collected interferogram which affect the detection accuracy of the system because of bad splitting effect of beam splitter, contaminated grating surface, unbalanced interferometer arms, uneven detector response spectrum, electronic circuit error, the dust in the test environment, test platform instability and other factors. Therefore, the noise removal and interference suppression of the interferogram generated by spatial heterodyne spectroscopy are one of the hot issues in the current academic research. Basic structure and principle of SHS were analyzed in detail and the interference and distortion of SHS application system which could influence the interferogram were analyzed and a correction scheme of SHS interferogram with strong robustness was proposed according to the existing interferogram processing scheme. The correction scheme includes noise suppression, baseline removal, flatness correction, apodization, phase correction and so on. Then, the SHS experimental platform was constructed by using helium-neon laser and sodium lamp respectively and the collected interferogram was analyzed by the scheme mentioned above. Finally, compared the two restoration spectrums got by the original interferogram and the correction interferogram respectively, it is found that the proposed scheme can not only effectively eliminate the interference information in the interferogram, but also reflect the input spectral information well and improve the inversion accuracy of the SHS system (The resolution limit error of the experimental platform 1 is 0.0004 mm^{-1} and the resolution limit error of the experimental platform 2 is 0.016 mm^{-1}, indicating that the actual resolution of the platform has good agreement with the theoretical resolution). The effectiveness and superiority of the scheme are verified. In addition, the proposed correction scheme for interferogram does not impose additional requirements on the application environment and equipment of the system so the scheme has high universality and provides some support for SHS research.

Keywords: spatial heterodyne spectrometer; distortion analysis; interferogram correction; inversion accuracy

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