FREQUENCY COMB VERNIER SPECTROSCOPY OF METHANE IN THE MID-IR WITH TEMPORAL RETRIEVAL OF COMB LINES

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We develop a spectroscopic method combining the broadband spectral coverage and frequency resolution of a frequency comb with the optical path enhancement of a resonant optical cavity. The method requires only one frequency comb laser. We present measurements of the methane absorption spectrum performed in ambient air in the mid-IR from 3μm to 4μm using a comb derived from difference frequency generation. The resonant cavity provides the dual purpose of optical path enhancement along with Vernier filtering of the comb modes, allowing individual comb modes to be resolved with a grating. As the resonant cavity length is scanned, the transmitted comb lines in the whole spectral range of the cavity reflectivity are continuously recorded with a mid-IR camera, yielding an absorption spectrum in seconds. We show how this method can be realized with fewer moving parts and with broader spectral coverage than similar techniques reported in the literature, along with showing how the technique can be modified to suit different mid-IR detectors.

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