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Information Extraction from Congested Molecular Spectra by Modulation Spectroscopy MOHAMMAD KHAN, KARAN MOHAN, AMIN DHARAMSI, Old Dominion University — Wavelength Modulation Spectroscopy (WMS) of molecular species is quantified utilizing concepts of entropy and information content. The optimal harmonic detection order (i.e. the one for which maximum information can be extracted in a noise environment) is found by theoretical considerations and then verified by experiment. The method developed, which can be used for precise measurements of molecular collision dynamics encoded in the absorption lineshape profile, is applied to resolution of very weak (spin-forbidden, magnetic dipole driven) overlapping lines of disparate oscillator strengths in molecular Oxygen A-Band. The complexity of the structure (turning points and zero crossings) of WMS provides an ultra sensitive probe, sensitive to small perturbations in the lineshape profile. For particular experimental limitations and noise environments, finite amounts of information can be transmitted by the probe interacting with the information source (the lineshape) to the detection apparatus. This information reaches a maximum value at an optimum detection order. The theory developed is applied to experimental measurements of four overlapping transitions in Oxygen A-band. It is shown that detection at harmonics greater than the commonly-used second are optimal in this case.

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