HYper Spectral Microwave Sounder *(HYMS)*

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Abstract— Space-borne heterodyne microwave 'Hyper-Spectral Imaging' (HPI) of Earth's atmosphere offers significant potential to greatly improve operational meteorological weather forecasting accuracy. By performing high-spectral resolution measurements of key atmospheric species (O_2 and H_2O) from space, a more accurate evaluation of global atmospheric temperature and water content distribution can be achieved. This information is used, in turn, to substantially increase the precision of advanced Numerical Weather Prediction (aNWP) models that are crucial in defining and predicting rapidly evolving weather phenomena [1].

Unfortunately, current and planned space-borne operational meteorological microwave remote sensing systems lack the necessary precision to support aNWP and, as a consequence, a serious gap exists in observational capability related to high altitudes (>40kM) [2]. To rectify this situation, future deployment of a fleet of microwave HPI spectrometers with spectral resolution order of better than 10^5 will be required. However, the appropriateness and benefits of the HPI technique must first be demonstrated. In order to achieve this key step, we are currently developing an airborne HPI microwave sounder operating in the (50 to 68) GHz frequency range and targeting the fine spectral structure of O_2 with a maximum spectral imaging capability of 1 MHz.

Our HYper-spectral Microwave Sounder (HYMS) will use a high-gain radio frequency (RF) low noise amplifier (LNA) followed by a frequency down-conversion stage comprising a pair of sub-harmonic mixers operating in a double sideband configuration. This will provide two RF spectral 'windows' that encompass (50.3 to 57.3) GHz and (63.3 to 67.9) GHz and the O_2 emission signature. High-spectral resolution is achieved through the use of a new ultra-wideband (8 GHz) digital Fast Fourier Transform (FFT) spectrometer. The required radiometric sensitivity is <0.4 K and this places significant demands on the system noise and requires the use of state-of-the-art component technology. In addition describing the application more detail, we will describe the radiometer system concept, design and development progress, and will present preliminary measurement results.

[1] *Aires, F. ; Prigent, C. ; Orlandi, E. et al. (2015) "Microwave hyperspectral measurements for temperature and humidity atmospheric profiling from satellite: The clear-sky case". Journal of Geophysical Research: Atmospheres, vol. 120(21), pp. 11334-11351. http://dx.doi.org/10.1002/2015JD023331*

[2] *Aires, F., and Pringent, C., "Use of spectral information at Microwave Region for Numerical Weather Prediction", ESA Contract 4000105721/12/NL/AF*