The Development of Infrared Remote Sensors for Chinese Meteorological Satellites

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***Abstract*—Meteorological satellites have become an irreplaceable weather and ocean observing tool. Since the first Chinese polar-orbiting meteorological satellite Feng-Yun (FY-1A) was launched successfully in 1988, there are totally 13 meteorological satellites that were launched into both sun synchronous and geostationary orbit. China is among the few countries in the world which are simultaneously operating both orbiting meteorological satellites. All the satellites have been incorporated into the global constellations of operational meteorological satellites within the WMO framework. More satellites are under construction to be the second generation ones. The status of Chinese meteorological satellite mission is introduced in this paper.**

I. INTRODUCTION

Infrared remote sensors are the main payloads on-board each satellite. As the unique remote sensor on-board the first generation polar-orbiting meteorological satellites (FY-1 series) and the geostationary orbit meteorological satellites (FY-2 series) separately, Multi-channel Visible and Infrared Scanning Radiometer (MVISR) and Visible and Infrared Spin-Scan Radiometer (VISSR) had been developed since 1970s'. The long-term operational ones have been working for over 10 years, and obtain the remote sensing data for ocean colour, SST, LST, water vapour, weather forecasting, etc. There are four type of infrared sensors which are carried aboard each platform of the second generation polar orbiting meteorological satellite (FY-3): the Visible and Infrared Radiometer (VIRR), Medium Resolution Spectral Imager (MERSI), Infrared Atmospheric Sounder (IRAS), Earth Radiation Measurer (ERM). As the results of the three launches of FY-3A, FY-3B and FY-3C satellites, three groups of these four sensors are currently operating on-orbit and providing not only the imaging data, but also the sounding data and Earth radiance budget data at the same time. MERSI surveys the earth with a ground pixel resolution of 250-metre and a swath width over 2900 km, that could get the global TIR (thermal infrared) image of 250-metre resolution twice each 24 hours. This specification is distinctive in the world and very useful for the environmental monitoring. As the upgrading sensors of MERSI and IRAS, MERSI-2 and High-spectral Infrared Atmospheric Sounder (HIRAS), focusing on imaging and sounding mission separately, are developed and will be launched with FY-3D in 2016. They will get more infrared channels and fine spectral data in the near future. Two type of infrared sensors, Advanced geostationary radiometric imager (AGRI) with 14 channels and geostationary interfering infrared sounder (GIIRS), are under construction for the new generation of the geostationary-orbit meteorological satellite (FY-4). HIRAS and GIIRS are nadir and limb viewing infrared Fourier transform spectrometers (FTS), which could be able to provide sounding data to users, and to get the atmospheric temperature profile and humidity profile. While these two infrared sensors are put into operation in 2016, China may be the first country that could get high spectral infrared data from both geostationary and polar-orbiting satellites.

Some tradeoffs have been made to build the infrared sensors. In accordance with specification and designing strategy, the following choices of single-pixel detector, linear detector and focal plane detectors, thermal cooler and mechanical cooler, different type of telescope, double-axis gimbaled mirror and single-axis scanning mirror, have been selected respectively. The characteristics of these infrared sensors, design overview conjoined with detector, cooling, optics, pointing, observation strategy, calibration strategy, etc. are introduced in this paper.