URSI-RCRS 2024, ARIES/GEHU, Bhimtal, India, 22 - 25 October, 2024

A new FM-Radio broadcast-based Meteor Detection System developed by a Multi-Channel Software Defined Radio (SDR)

Himanshu Sekhar Sethi and Nirvikar Dashora

National Atmospheric Research Laboratory, Department of Space, Government of India, Gadanki-517 112, INDIA

Corresponding author: ndashora@narl.gov.in

Abstract

A low cost in-house FM radio-based software-defined radio receiver for detecting meteor echoes using universal serial radio peripheral (USRP) front end, GNURadio was developed recently by us (Sethi and Dashora, 2022). This setup used Yagi antenna connected with a GNURadio based SDR receiver tuned to record FM radio broadcasts. An automated algorithm was developed to classify and store meteor echoes in form of IQ data. This paper presents new observations from this very small system which is operated to detect all those types of meteor echoes which have been reported earlier by high-power large aperture (HPLA) radars. Additionally, the angle of arrival is estimated using two antenna separated by 2λ.The majority of detected meteor echoes are found to be Overdense meteors. With modified set up, effect of transmitter power on meteor count is validated by observing meteor echoes using multiple FM Radio stations broadcasting over frequencies between 98 MHz and 104 MHz located around Gadanki. Signatures of fragmentation, ablation and background wind are also observed in the form of different amplitude and phase patterns. Various applications of reflected signal from meteor trails for atmospheric sciences such as ozone concentration, ambipolar diffusion, and zonal wind are elucidated. Height of meteor echoes is estimated empirically using decay time of meteor echoes. The results will be presented to demonstrate that this novel inexpensive, low-power, portable, flexible and passive multi-channel meteor detection system can be highly useful for understanding the meteor phenomena and estimation of atmospheric parameters.

Keywords: Meteor, SDR, Passive, Low-cost, FM Radio, Meteor counts