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Meteoroid trajectories from BRAMS data

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BRAMS (Belgian RAdio Meteor Stations) is a Belgian radio network using forward scatter observations to detect and characterize meteoroids. A dedicated transmitter located in south of Belgium emits a CW signal with no modulation at a frequency of 49.97 MHz and with a power of 130 W. The network comprises currently 35 similar receiving stations located in Belgium and neighboring countries. They use Yagi antennas with a wide sensitivity pattern which therefore provide no information about the directivity of the meteor echoes. One of these stations is however a radio interferometer using the classical Jones configuration and is able to retrieve the direction of the meteor echoes.

We discuss here a general method to retrieve meteoroid trajectories based solely on time delays measured between meteor echoes recorded at multiple receiving stations. It is based on solving at least 6 non-linear equations to solve for the position of one specular reflection point (3 unknowns) and the 3 components of the speed. This method has also been described recently in Mazur et al (2020) and applied to CMOR data. However, specificities of the CMOR configuration has allowed simplifications that cannot be made with the BRAMS network. In order to maximize the number of meteoroid trajectories with at least 6 stations detecting meteor echoes, a number of additional stations geographically close to each other have been installed in the Limburg province in 2020. Another method to retrieve meteoroid trajectories using data from the radio interferometer and from 3 other stations is also presented.

We show preliminary results from both methods using also complementary data from the optical CAMS Benelux network. The CAMS trajectories are used to select specific meteor echoes in the BRAMS data. The time delays between them are computed and used to solve the set of non-linear equations to retrieve the meteoroid trajectory and speed, which are then compared to the CAMS values. This allows us to assess the accuracy of both methods.

Finally we simulate the impact of using additional information, not currently available but that might become in a near future. This includes data from a monostatic system (a radar nearby our BRAMS transmitter is currently built), from a second radio interferometer (to be located in Limburg and/or near the transmitter), or the total range traveled by the radio wave if a coded CW transmitter such as in Vierinen et al (2016) is used.