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3-D Rain Rate Estimation from Integrated Measurements of Commercial Wireless and Satellite Links: an overview

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Abstract

In the last decade, various algorithms have been developed to provide accurate rainfall maps from measurements of rain-induced attenuation on commercial wireless links (CWLs).
These solutions are able to give precise results but they also require dense terrestrial microwave networks, which have non negligible installation and operating costs.
A cheaper alternative for rainfall estimation is represented by broadcast satellites links (BSLs).
However, estimation of the rain-induced attenuation on satellite links requires complex signal processing techniques, due to the physical structure of these links. Furthermore, to the best of authors' knowledge, data provided by satellite links only cannot be used to properly estimate a precise rainfall map of an area.

To overcome these problems, we studied a mixed approach based on data given by both CML and BSL, able to provide a three-dimensional (3-D) rain rate map of a monitored area.
The proposed joint approach gives us remarkable appealing advantages:
1. **Efficiency**: both CWLs and BSLs exploit already existing wireless infrastructure, at no extra costs for the required equipments, the installation and operating conditions.
2. **Coverage**: CWL coverage can be improved by including satellite terminals already installed at domestic premises for TV reception. Additionally, more satellite devices can be purposely installed in areas not adequately covered by terrestrial microwave links, where the deployment of conventional methods of observation, as rain gauges and weather radars, is impractical.
3. **Diversity**: measuring the signal levels coming from different links, terrestrial and satellite, provides a diversity gain which is the key to improve the accuracy and reliability of the overall joint system.
4. **Accuracy**: the numerical results obtained by simulations corroborate the effectiveness of the proposed mixed 3-D strategy and quantify the improvements over the conventional systems based on CWLs only.
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Our contribution lies in the description of the data processing schemes developed to retrieve these maps.
In particular, the first part consist in pointing out the problems connected to the satellites links and a signal processing approach able to provide precise data of estimated rainfall.
Then, a summary of the algorithm will given and preliminary results obtained by the proposed approach will be presented, in order to show the effectiveness of our approach.

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