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MUSIC Localization of Radio-Frequency Sources Using Field Distributions Measured by Metasurface Absorber

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Extended Abstract

For identifying radio-frequency (RF) noise sources in electric and electronic devices under actual operating conditions, an effective way is to measure the radiated field distributions around the sources. So far we have developed an "RF field imaging system" to monitor 2-d power and phase distributions of a radio wave at a few GHz incident on a thin metasurface absorber [1]. In this study, the field distributions measured by the system are used to localize the RF sources, by using the MUSIC algorithm.

The metasurface absorber is composed of a mushroom-type high impedance surface, where a 2-d array of square metal patches are formed on the surface of a grounded thin substrate. Absorption is achieved by an array of lumped resistors interconnecting the surface patches, which are matched with the incident wave impedance at the resonance frequency of the metasurface. The lumped resisters inserted between the adjacent patches, arranged in the row (x) and column (y) directions, behave like an array antenna receiving the x- and y-polarized components of incident electric field, respectively. By measuring the voltage (amplitude and phase) on each lumped resistor, 2-d amplitude and phase distributions of incident electric fields are obtained on the absorber surface [1].

The measured electric field distributions are then used to localize the sources which have radiated the RF waves illuminating the absorber surface. Here the MUSIC algorithm is applied to the amplitude and phase profiles measured at multiple points on the metasurface, to estimate the locations and orientations of the radiating near-field sources. An arbitrary set of measurement points are selected on the metasurface absorber, for the estimation of incoherent multiple sources. Estimation of a few coherent sources is also feasible on the basis of a "spatio-temporal independent topography" model [2]. The performance of the technique is evaluated using electromagnetic simulations and actual experiments. It is confirmed that accurate source localization is basically possible for example electric dipole sources existing within one meter from the metasurface absorber of several tens of centimeters square.

References

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