Journal & Proceedings of the Royal Society of New South Wales, vol. 154, part 2, 2021, p. 257. ISSN 0035-9173/21/020257-01

Thesis abstract

Fast and accurate estimation of angle-of-arrival in millimetre-wave large-scale hybrid arrays

Kai Wu

Abstract of a thesis for a Doctorate of Philosophy submitted to the University of Technology Sydney, Australia

Hybrid array is able to leverage array gains, transceiver sizes and costs for massive multiple-input-multiple-output (MIMO) systems in millimetre wave frequencies. Challenges arise from estimation of angle-of-arrival (AoA) in hybrid arrays, due to the array structure and the resultant estimation ambiguities and susceptibility to noises. In this thesis, we study the unambiguous and non-iterative AoA estimation in two types of hybrid arrays — Localized Hybrid Array of Phased SubArrays (LHA-PSAs) and Lens Antenna Arrays (LAAs). For each type, two AoA estimation approaches are proposed for narrowband and wideband, respectively. The main innovation of the approaches include:

- The deterministic sign rules and patterns in LHA-PSAs are unprecedentedly discovered, and exploited to eliminate the estimation ambiguities;
- The optimal trade-off between different error sources is achieved, minimising the wideband AoA estimation error in LHA-PSAs;
- A new wide beam synthesis method is developed for LAAs, which substantially improves the AoA estimation efficiency in LAAs;
- New spatial-frequency patterns are unveiled exploiting the spatial-wideband effect, leading to fast and accurate wideband AoA estimation in LAAs.

Performance analysis is provided for all the approaches with closed-form estimation (lower) bounds derived. Corroborated by simulations, our approaches are able to dramatically improve AoA estimation accuracy while reducing complexity and the number of training symbols, as compared to the state of the art. The estimation errors of our methods asymptotically approach the (lower) bounds.

Dr Kai Wu
Global Big Data and Technologies Centre
University of Technology Sydney
Sydney NSW 2007
Australia

E-mail: Kai.Wu@uts.edu.au

URL: http://hdl.handle.net/10453/140253