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IRS-aided Beam Alignment

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Description: The future generation communication networks will be operated mainly at millimeter wave (mmWave) or even higher frequency bands in order to achieve high spectral efficiency as well as accurate localization/positioning, necessary for emerging autonomous applications. At such a high frequency bands, beamforming both at the transmitter and the receiver, or beam alignment (BA), is considered essential to compensate the high propagation and penetration loss. The design of BA achieving a good tradeoff between alignment accuracy and resource overhead has been extensively studied in the literature [1, 2]. In particular, a number of recent works proposed to exploit some side information, such as location [3, 4], database [5], or radar [6], at the base station side to speed up the initial acquisition time.

Intelligent reflecting surface (IRS) consists of a large number of passive reflecting elements that can be easily controlled at a base station or access points to cooperatively beamform without the need of any radio-frequency (RF) chains. So far, a number of recent works showed that IRS can be used as an external fixed helper to increase the coverage, mitigate the interference of the network ([7] and references therein). Due to its low cost together with the advanced, future user terminals can be also equipped with small IRS. This IRS-integrated device provides a new opportunity that we wish to exploit to speed up the BA protocol.

In this mater thesis, we study IRS-aided BA and quantify how much the resource can be saved as a function of the IRS parameters. To this end, we aim to organize the work as follows:

- Understand the basic of IRS and mmWave BA.

- Study various types of IRS space-time (coding) functions to control passive reflecting elements [8].

- Study the tradeoff between the alignment accuracy and the required resource.

Prerequisites:

- Solid background in signal processing and optimization.

- Matlab programming skills.

References

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