Timing, among other factors, improves aging in next-generation wireless communications

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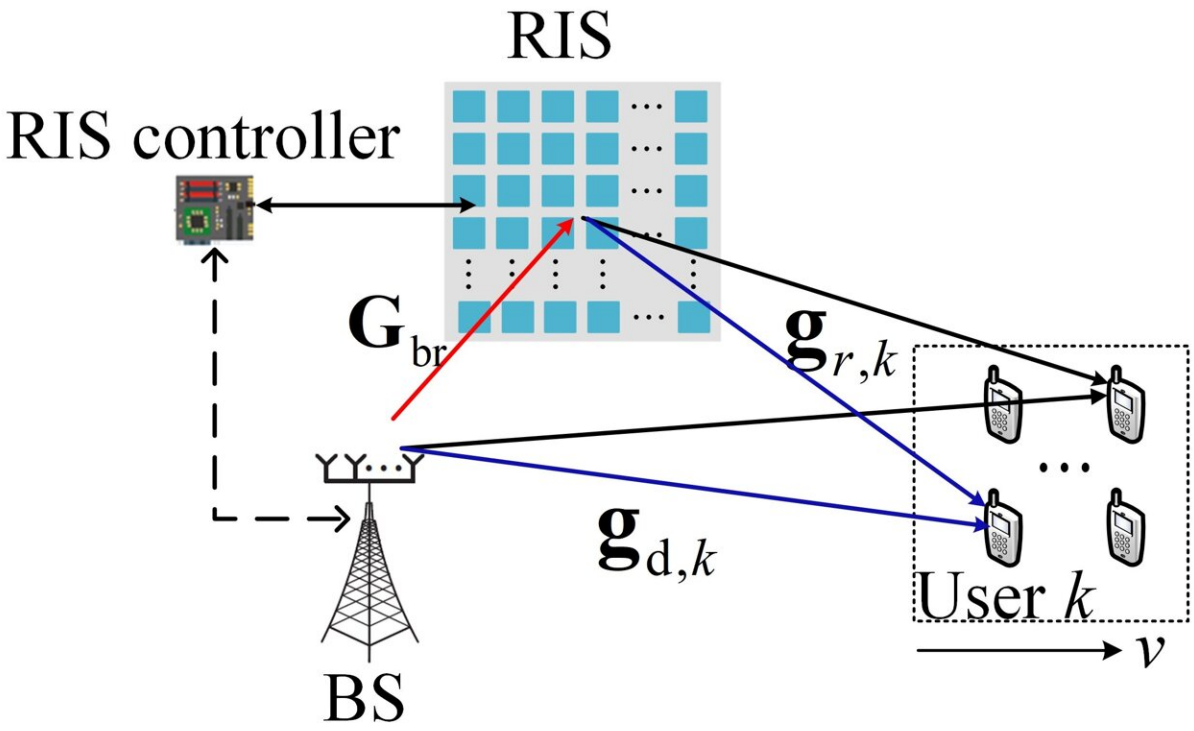

A multi-user MISO communication system is considered, where a BS equipped withNt antennas serves K (K

In wireless communications, channels can not only change, but they can also age. For contemporary systems, these connections between the transmitter and the receiver break down over time, user movement and power dissipation. Understanding how channels age in future systems, as well as how to mitigate such issues, are key to developing the next generation of wireless

communications, according to an international collaboration studying the topic in reconfigurable intelligent surface (RIS)-assisted systems.

Researchers published an analysis of how RIS-assisted communication systems perform under channel aging on April 29 in *Intelligent and Converged Networks*.

RISs are arrays comprising individually programmable and controlled circuits that can dynamically reflect signals and may be the linchpin platform to achieve 6G wireless communications, according to first author Yan Zhang, School of Electronic and Information Engineering, Beijing Jiaotong University.

"Investigating the performance of RIS-assisted communication systems under the condition of channel aging can verify whether deploying an RIS in a wireless communication system can reduce the adverse impact of channel aging on system performance and how much performance gain it can bring," Zhang said. "This is helpful to provide a theoretical basis for the system optimization design of RIS-assisted communication systems."

All three components of the communication system can move: the RIS may be a satellite, the base station moves as the Earth rotates and the users are unpredictably mobile. Add in modifications to the communication environment, such as physical barriers or weather interference, and the channels of communication will continuously change over time.

"These factors lead to the so-called channel aging phenomenon where the channels vary across time with correlated channel variables in a transmission," Zhang said. "Channel aging results in a mismatch between the current and estimated channels that degrades the system performance. But, to the best of our knowledge, there is a lack of studies on the impact of channel aging on RIS-assisted communications systems. Since RIS will help evolve wireless communication, it is of great importance to analyze how RISs can improve the channel quality with user mobility."

The researchers examined how deploying an RIS in a wireless communication system affects the adverse impact of channel aging on system performance. They modeled a system in which a base station simultaneously sends signals to an RIS and to individual cell phone users. The RIS reflects the signal to the same users,

duplicating and strengthening the signal. In this model, the RIS and base station are stationary while the users are moving in a single direction at the same velocity, such as on a highway.

The system mathematically estimates the best channel to send a signal, depending on location, movement, potential barriers and several other factors. The channel varies from the time it is estimated to when it is used to send or detect the signal—this is the aging phenomenon.

"Due to the existence of an extra end-to-end signal propagation path established by the RIS, we found that RISs can reduce the adverse effects of channel aging on the communication system, as well as improve the overall system performance, compared to systems without an RIS," Zhang said, "Moreover, the system performance improved as the total transmit power and the number of antennas at the base station, the number of the RIS's reflecting elements and the temporal correlation coefficient increased."

But, Zhang said, while the RIS can increase transmission capacity by adding reflecting elements, it does not have infinite capacity since it will eventually become saturated.

"This analysis is helpful in providing a theoretical basis for the system optimization design of RIS-assisted communication systems," Zhang said. "The study can be further generalized along with several promising future work directions, as well. For example, we can apply this approach to the study of spatially correlated fading and more efficient channel estimation methods, to name just a few."

More information: Yan Zhang et al, Performance analysis of reconfigurable intelligent surface assisted systems under channel aging, *Intelligent and Converged Networks* (2022). DOI: 10.23919/ICN.2022.0002

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