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A Novel Framework for ISAC-FD-enabled URLLC Systems in Automation Applications

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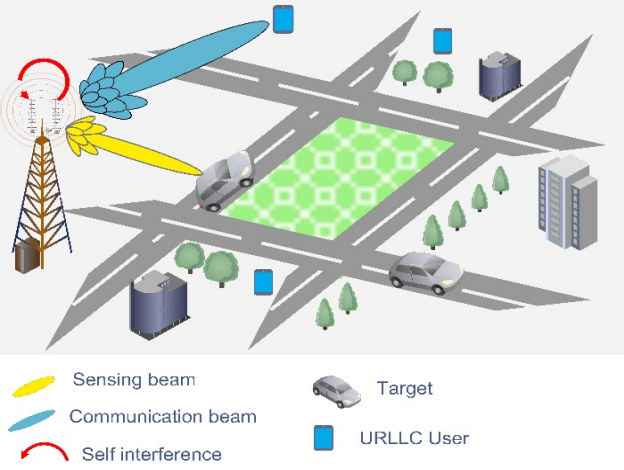
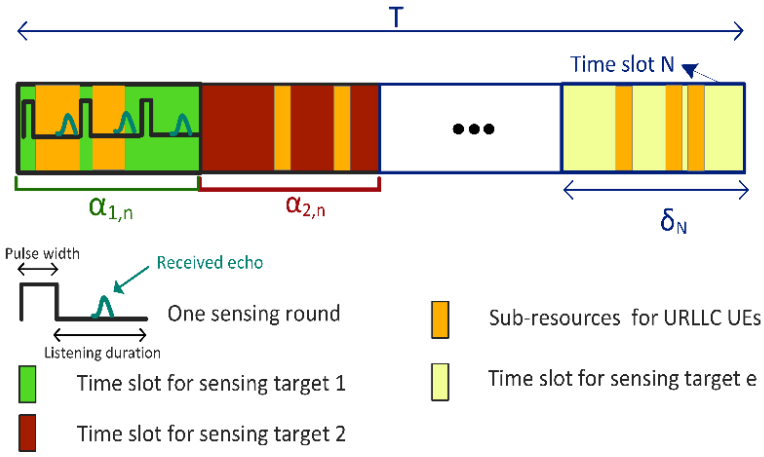
Is it possible to make a coexistence between ISAC-based networks and URLLC service for the automation applications? What is the self-interference effect on the ultra-reliable ISAC networks?





Toward the realization of the automation scenario, we propose a novel framework with the potential of accurate environmental monitoring simultaneously with supporting the URLLC users for ISAC-based networks. As we considered monostatic radar, it is assumed that the self-interference (SI) from communication beams affects the sensing accuracy within the listening time. Focusing on the URLLC use cases that have more strict KPIs and eventually more resource demand, the SI effect is stronger in the mentioned scenario.

KEY FINDINGS

Investigating the coexistence between monostatic ISAC and URLLC service is vital for realizing practical automation scenarios. As residual SI is always a practical issue in monostatic radars, we model the residual interference effect on the sensing accuracy concerning the CRB metric. To be more precise, we propose a framework guaranteeing KPIs for both sensing and URLLC services addressing the SI issue. Therefore, we moderate the tolerable delay supporting the URLLC service opportunistically within the listening times of the radar. Moreover, we aim to provide a proper optimization scheme for the latency, sensing pulse width, and beamforming design to realize adaptive scheduling that is beneficial for sensing accuracy and communication QoS in terms of the CRB, supporting the traffic load of URLLC users with the delay requirement. Furthermore, it is worth mentioning that the proposed framework also positively limits the SI influence which poses a serious challenge in the ISAC, energy demand, and the radar range.

Consequently, we evaluate how the proposed algorithm is sufficient in balancing the trade-off between strict sensing and communication by providing a proper beamforming strategy and sensing time optimization. Furthermore, we illustrate how the residual SI deteriorates the sensing quality and consequently affects energy consumption to make sure of a standard quality of service.

Atefeh Rezaei, Ata Khalili, Falko Dressler, Robert Schober, "A Novel Framework for ISAC-FD-enabled URLLC Systems in Automation Applications," in progress, 2024.