Timing Synchronization in Cell-free Massive MIMO Systems – DST-SERB

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Theme: Development of Suitable Initial Access/ Random Access (RA) Procedure for the Cell-free (CF) massive MIMO systems for facilitating its Practical Implementation (*ICT Infrastructure development*)

- Conventional cellular LTE/ massive MIMO networks use RA to estimate propagation delay for users → users advance their uplink frame (Timing Advance (TA)) → all users' data are received at the base stations (BSs)/ network access points (NAPs) synchronously (Timing Synchronization)
  - RA procedure is important for *NAP-user association* and *connection establishment*, *resource allocation* and *synchronized transmission*
- In CF massive MIMO, each user is served by *more than one NAPs* simultaneously → TA information different for the same user at different NAP → Existing RA procedure and corresponding resource allocation strategy not suitable for CF massive MIMO

Objective:

- To develop a suitable method to estimate TA from multiple delay estimates and a strategy for resource allocation and collision resolution
- To analyze the effects of frequency offsets on the RA procedure for CF massive MIMO systems
- To analyze the effect of clock timing mismatch between the CF massive MIMO and users and devise a remedy to improve the system performance

Deliverables: High quality research publications/patents for standardization of implementation of CF massive MIMO systems

❖ **Outcome through Project:**
  - Suitable method for *establishing user connectivity* and maintaining quality of service (QoS) in CF massive MIMO systems → Wireless *network with uniform QoS* across the network can be realized
❖ **Societal Impact:**
  - Very few users will experience poor QoS/ connections
  - Improved wireless connectivity is *suitable for IoT infrastructure*/ network deployment → helpful for developing automated services (e.g. health monitoring, traffic control etc.) → Useful for development of *smart city initiatives* (ICT infrastructure development)
❖ **Current Status:**
  - We are currently developing suitable strategy for collision resolution and user identification through joint processing of received training data at the NAPs.