**Problem Formulation**

- Sensor network as an undirected graph \( \mathcal{G}(V, E) \) of order \( n \)
  - Stationary sensors located at positions, \( s_i \in \mathbb{R}^2 \)
- Target position \( p(t) \in \mathbb{R}^2 \)
  \( p(t) = v(t) \)
- Measurements are unit vectors \( \varphi_i(t) \)
  \( \varphi_i(t) = \frac{p(t) - s_i}{\|p(t) - s_i\|_2} \)
- Define \( \rho_i(t) = \|p(t) - s_i\|_2 \) and \( \varphi_i(t) = \left[ \cos(\theta_i(t)) \sin(\theta_i(t)) \right]^T \)
- \( \rho_i(t)\varphi_i(t) = p(t) - s_i \)

**Distributed Algorithm**

- In terms of local quantities \( p^*(t) = \left( \frac{1}{n} \sum_{i=1}^{n} h_i(t) h_i^T(t) \right)^{-1} \left( \frac{1}{n} \sum_{i=1}^{n} h_i(t) z_i(t) \right) \)
- Let \( P_i(t) = h_i(t) h_i^T(t) \) and \( q_i(t) = z_i(t) h_i(t) \)
  \( p^*(t) = \left( \frac{1}{n} \sum_{i=1}^{n} P_i(t) \right)^{-1} \frac{1}{n} \sum_{i=1}^{n} q_i(t) \)
- Construct a vector \( \phi_i(t) \in \mathbb{R}^6 \)
  \( \phi_i(t) = \left[ \text{vec}(P_i(t)) \mid q_i(t) \right] \)
- Time-varying average
  \( \bar{\phi}(t) = \frac{1}{n} \sum_{i=1}^{n} \phi_i(t) = \frac{1}{n} (1_n \otimes I_6) \phi(t) \)

**Dynamic average consensus (DAC)**

- DAC algorithm
  \( \bar{w}_i(t) = -\beta \sum_{j=1}^{n} a_{ij} \text{sgn} \{ x_i(t) - x_j(t) \} \)
  \( x_i(t) = u_i(t) + \phi_i(t) \)
  \( w_i(t) \in \mathbb{R}^6 \) is the internal states
  \( x_i(t) \in \mathbb{R}^6 \) is the estimate of \( \phi(t) \)
- In a compact form
  \( \bar{w}(t) = -\beta (B \otimes I_6) \text{sgn} \{ (B^T \otimes I_6) \bar{x}(t) \} \)
  \( \bar{x}(t) = \bar{x}(t) + \phi(t) \)
- Define
  \( w(t) = \text{vec}(P(t)) \)
  \( x(t) = w(t) + (M \otimes I_6) \phi(t) \)

**Conclusion**

- Distributed algorithm to track maneuvering targets from bearing measurements
- Built on the dynamic average consensus algorithm
- Can be easily extended to discrete-time scenarios
- Future research include extension to noisy scenarios and privacy preserving & event-triggered communication schemes

**Numerical Results**

- Parameters: \( \gamma = 10^2, \hat{n} = 5 \), and \( \tilde{\lambda}_2 = 0.4 \)