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SenSync

Accurate and Real-Time Passive Sensing

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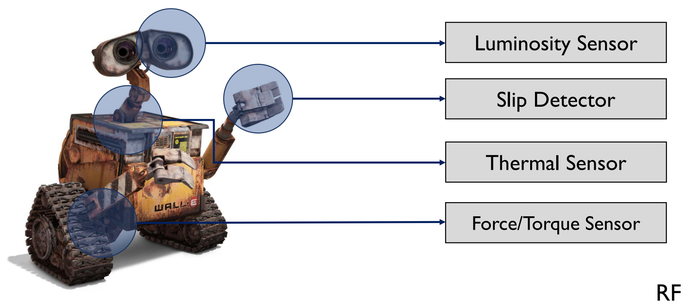
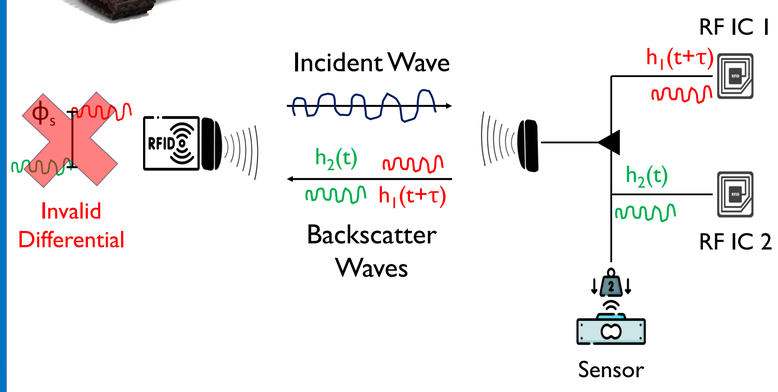
IEEE
WCSNG
Wireless Communications Sensing and Networking

Differential RFID Sensing





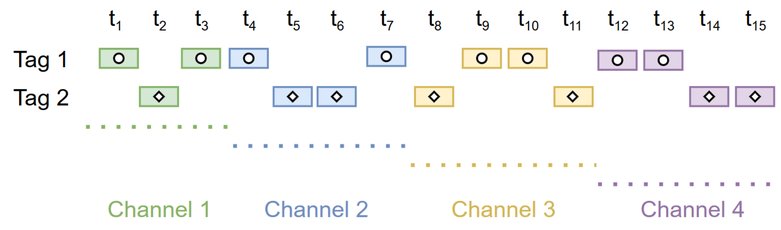
$$\Phi_1 = \{ \Phi_1{}^c(t_n) \mid c \in \{1, 2, ..., C\}, n \in \{1, 2, ..., N\} \}$$

$$\Phi_2 = \{ \Phi_2{}^c(t_m + \tau_{c,m}) \mid c \in \{1, 2, ..., C\}, m \in \{1, 2, ..., M\} \}$$

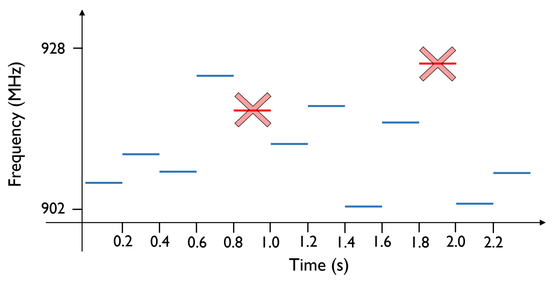
RF ICs Out of Sync: Staggered Data, Corrupted Results

Caveats with COTS Readers

Sequential Data Processing



Frequency Hopping

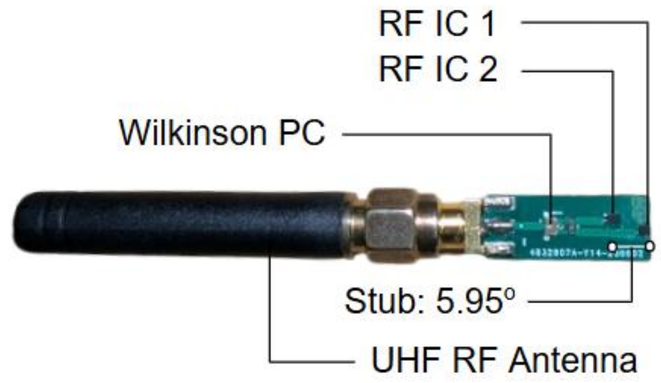


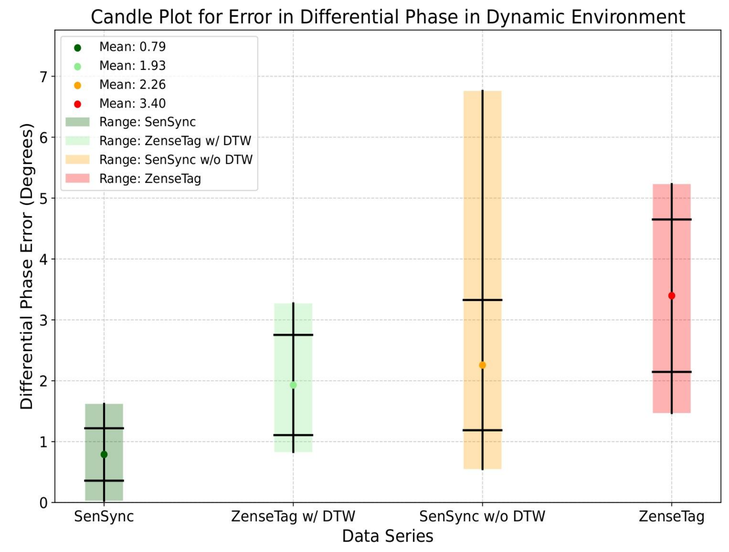
15% chance of phase corruption during frequency hops due to the arbitrary π phase jumps introduced by the COTS reader

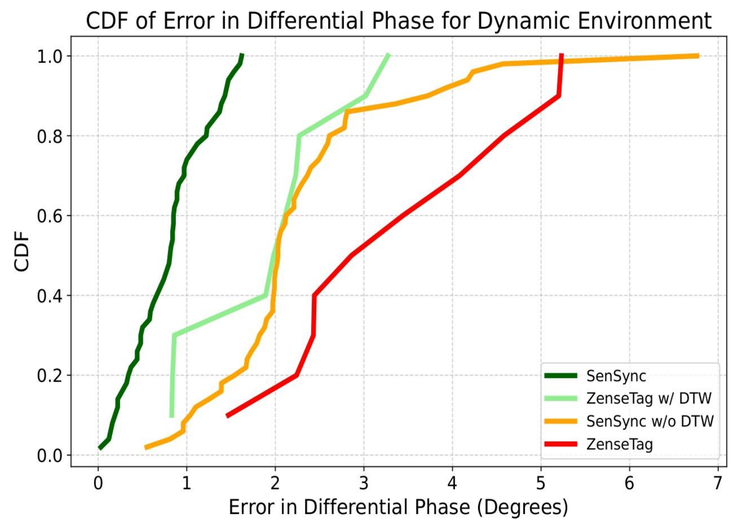
Sensor Data: Flicker of Truth?
Data Stream Retrieval can Deceive

The Proof of the Pudding is in the Eating!

Simulatory Stubbed Tag (SST)

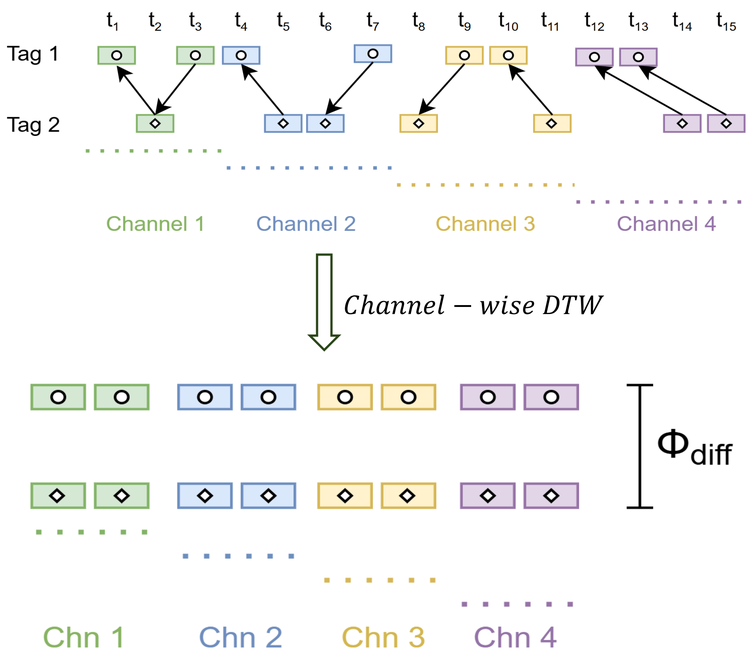






Solving the Data Puzzle

Secret Sauce – Dynamic Time Warping

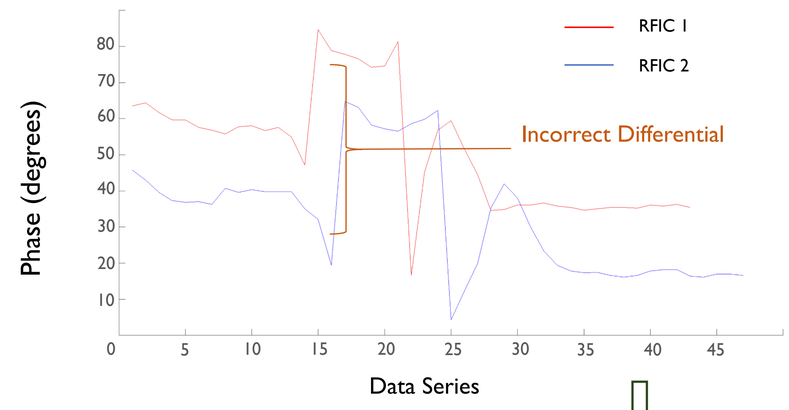


$$\Phi_{diff}{}^c(t_i) = | \Phi_1{}^c(t_i) - \Phi_2{}^c(t_i) | \ \forall\ t_i \in W,\ c \in \{1, 2, 3, 4\}$$

$$\Phi_{diff} = (\overline{\Phi}_{diff}{}^1(t_i) + \overline{\Phi}_{diff}{}^2(t_i) + \overline{\Phi}_{diff}{}^3(t_i) + \overline{\Phi}_{diff}{}^4(t_i)) \ / \ \sum_1^N i$$

Reliability Redefined: Transforming Chaotic RFID signals into Clear Sensing data

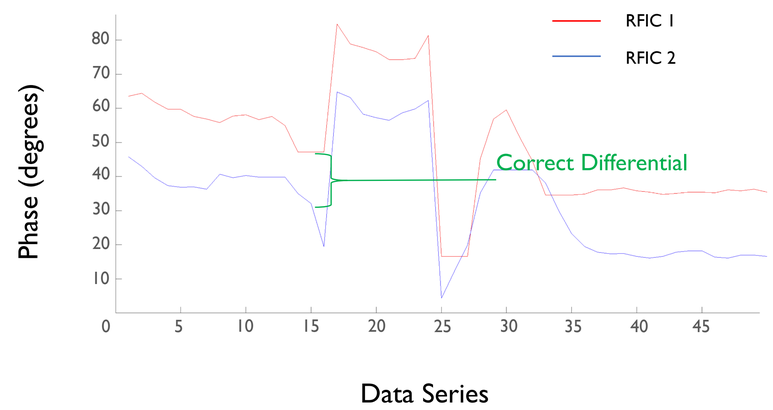
Reality Realigned



μ_{diff} : 23.82°, σ_{diff} : 14.6° | $Error_{diff}$: 100%

SenSync

Actual Phase Difference: 11.9° (roundtrip)



μ_{diff} : 11.45°, σ_{diff} : 2.3° | $Error_{diff}$: 4%

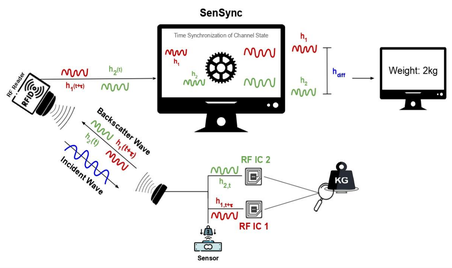
Sequence Alignment unlocks Meaningful Phase Insights

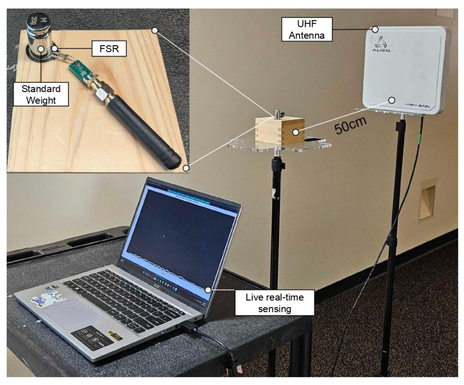
When Less is More: SenSync is **4x** more accurate at sensing capabilities than State-of-the-Art Sensing Systems

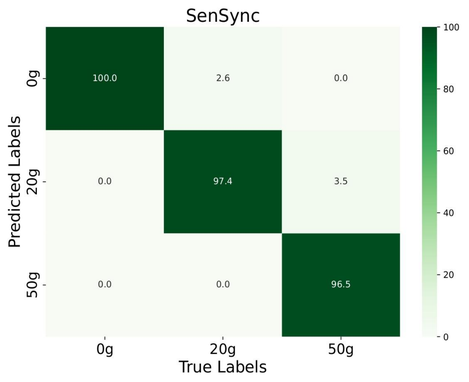
The Clear Winner

SenSync achieves:

- **4x** better accuracy than State-of-Art techniques
- **5x** improvement in sensing latency
- **8x** improvement in sensing data throughput
- **97%** accuracy when detecting weights as low as 20g and 50g







Summary

SenSync is an innovative algorithm that significantly improves RFID-based differential sensing. It addresses temporal misalignment and phase ambiguity issues, achieving **5× faster** sensory resolution and **8× higher throughput** compared to existing methods. SenSync demonstrates superior accuracy and robustness in dynamic environments.