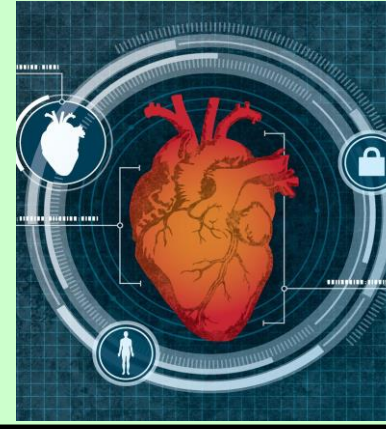


Cardiac Biometrics for Continuous and Non-contact Mobile Authentication

Wenyao Xu, PI, Associate Professor



<https://cse.buffalo.edu/~wenyaoxu/>



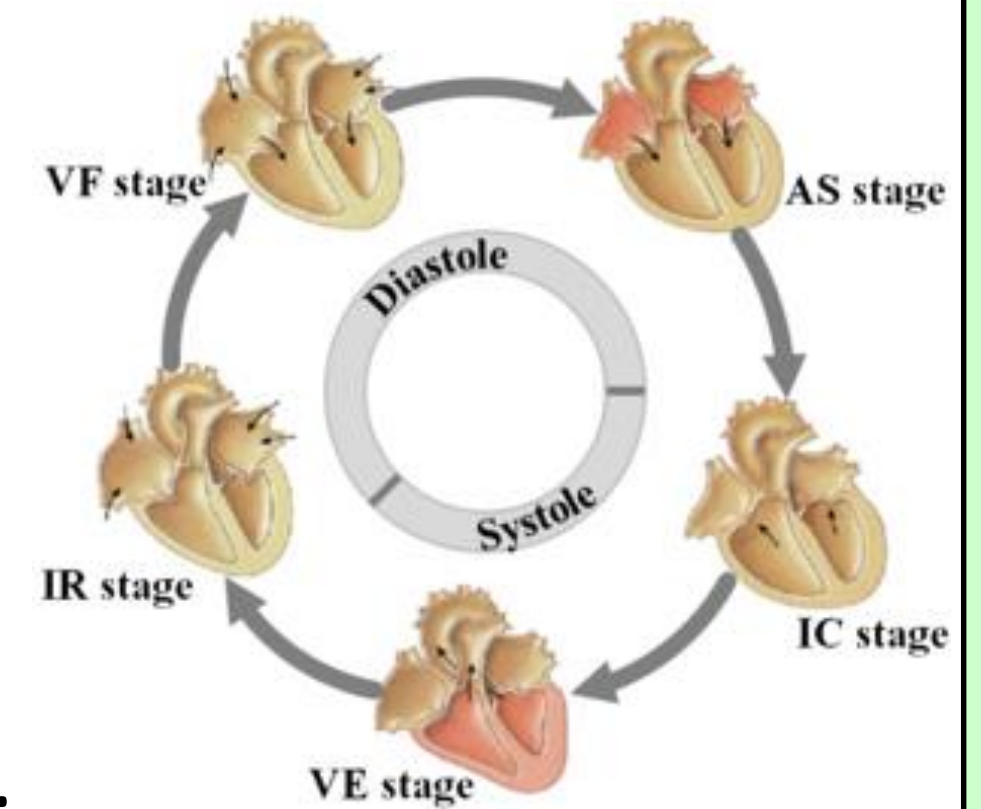
Introduction:

Cardiac motion

- Automatic heart deformation is caused by the self-excitement of cardiac muscle.
- Everyone's cardiac motion is unique, non-volitional, and secure.

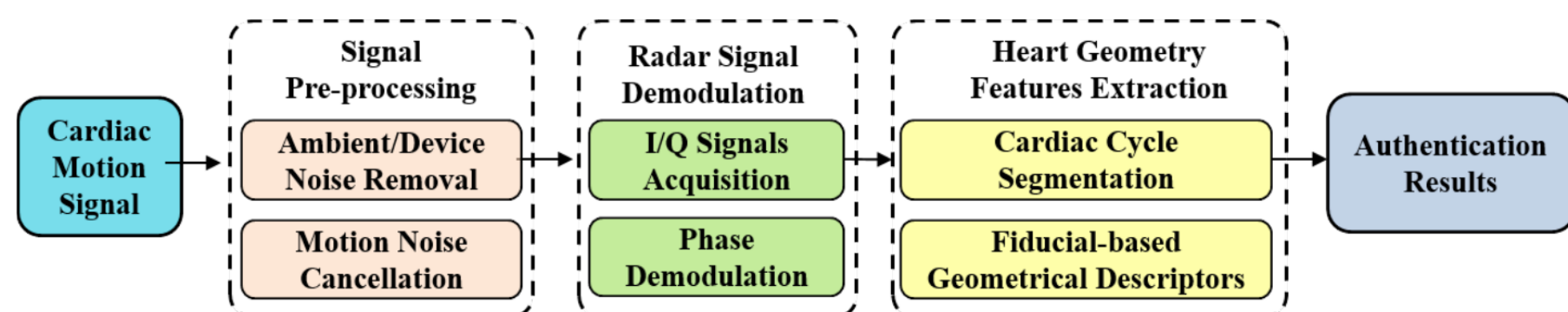
Our idea

- **Non-contact cardiac motion-based biometrics for continuous authentication.**



Challenges:

1. Sensing **high-resolution** cardiac motion information **unobtrusively**.
2. Extract invariant **geometric-based** features for each heart regarding the **cardiac motion** mechanism.
3. Examine the **usability** and **security** of the continuous authentication scheme.

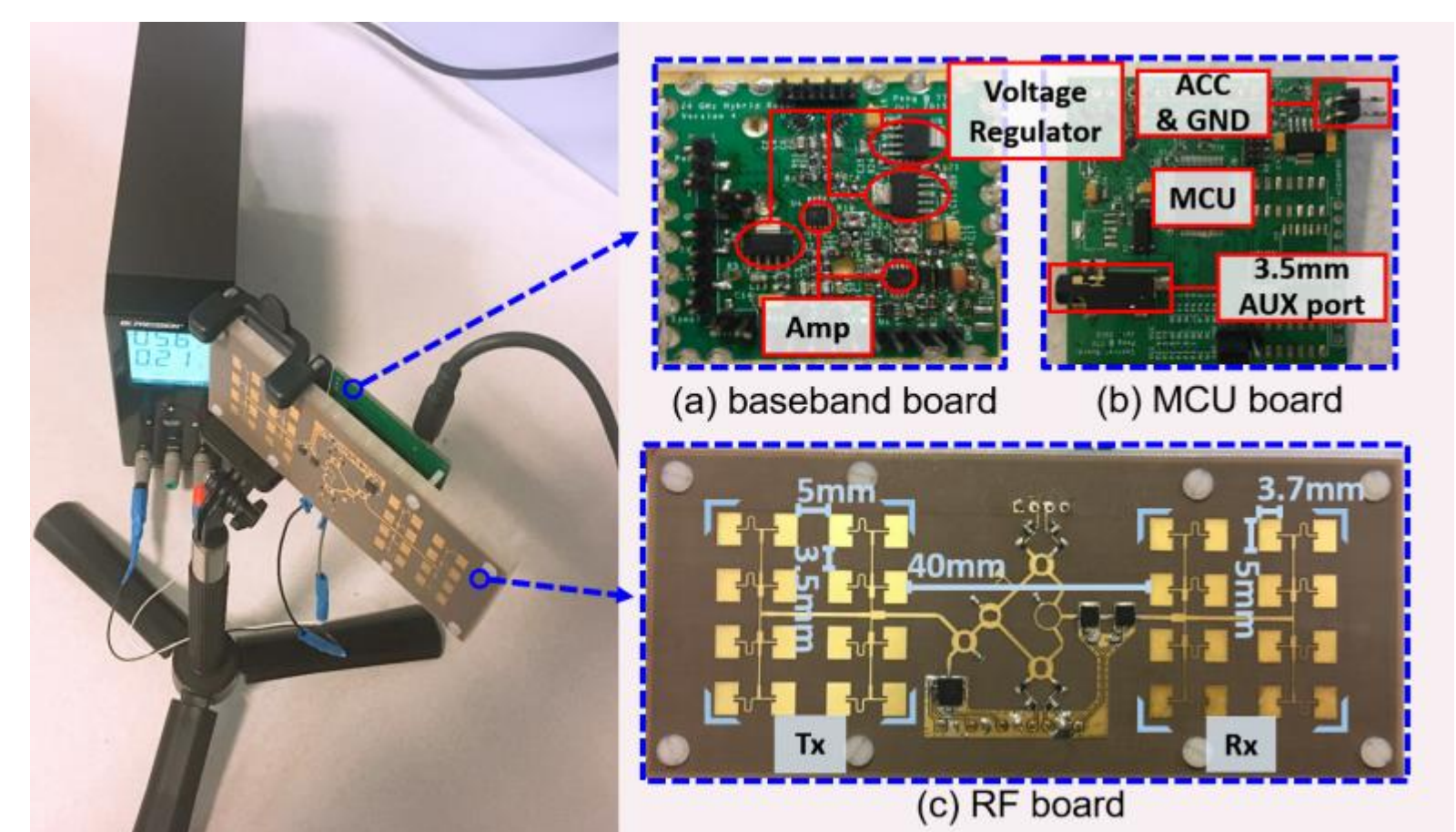


Contributions:

1. We prove the identifiability in cardiac motion with a **pilot study**.
2. We explore new **non-contact cardiac motion-based biometrics for continuous authentication** with millimeter wave.
3. We transform existing cardiac authentication systems into a more **undeceivable, disclosure-resistant and user-friendly solution**.

Key innovations:

1. We enable **non-contact** cardiac motion-based **continuous** biometric authentication with millimeter wave (mmWave) radar probe.
2. We develop a new mmWave wave radar **sensor**, design an authentication **algorithm**, and perform intensive evaluation **experiments**.



Hardware:

We support our implementation with following hardware innovation:

1. We develop a **smart DC-couple continuous-wave Doppler radar** sensor to continuously capture the high-resolution cardiac motion information.
2. We enable **synchronization** in both timing and radar probe signal phase and intensity for multiple mmWave radars.

Algorithm:

We design an algorithmic solution to complete implementation:

1. We isolate cardiac motion based **mmWave signal**.
2. We identify **fiducial descriptors** of cardiac motion based on the heart geometric characteristics.
3. We develop a user-friendly **continuous authentication protocol** to prevent malicious adversaries.

Experiment:

We evaluate Cardiac Scan through a set of multi-scene evaluations

1. Authentication with **unaligned sensors**.
2. Authentication with **different emotional states**.
3. Authentication while **in motion**.
4. Authentication under **replay attack**.

[1] <https://medium.com/@s.boutorabi/8-authentication-trends-for-the-online-payment-industry-2019-beyond-9f279e9f0c2e>

[2] <https://healthmetrics.heart.org/wp-content/uploads/2017/10/Cardiovascular-Disease-A-Costly-Burden.pdf>

