**Touch-Based System for Hemodynamic Parameters Estimation**

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### MOTIVATION

**Congestive heart failure**

- Heart fails to pump enough blood.
- Causes: High blood pressure, tobacco, lack of sport.
- Symptoms: Fluid increase in the thoracic cavity

**Prevention - Hemodynamic parameters estimation**

- Invasive method (Medically approved, hospital use, expensive)
- Non-invasive method: Impedance Cardiography (ICG) (Medically unapproved, simple, cheap)

Non-invasive assessment of parameters through ICG!

### IMPEDANCE CARDIOGRAPHY (ICG)

- AC current is passed across the body
- Current path depends on the frequency
- \[ \text{Resistance} = \frac{1}{\text{volume that contains water & electrolytes}} \]
- \[ \text{Voltage} = \text{Current} \times \text{Resistance} \]
- \[ \text{ICG} = \frac{d\text{Voltage}}{dt} \]

Traditional setup

ICG is linked to the fluid level!

### ICG DEVICES AND MAIN CONTRIBUTIONS

**ICG Devices**

- Philips ICG monitor [1]
- Multi-Parameter Patient Monitor [2]
- Measuring board based on ECG/ICG [3]

**Disadvantages**:

- Sensing electrodes placed on the body
- Lack of portability

Unsuitable for ambulatory & home-based monitoring!

**Main Contributions**

- Touch-based device for ECG/ICG acquisition
- Real-time algorithms for embedded filtering
- Hemodynamic parameters estimation

### TOUCH-BASED ULTRA-LOW POWER DEVICE

**Device**

- Real-time ECG/ICG acquisition
- Adjustable frequencies:
  - Sampling frequencies
  - Frequency of injected current

**Node architecture**

- Battery
- PMU
- Accelerometer
- Gyroscope
- Radio
- STM32L151
- ECG sensor
- ICG sensor

**Software component**

- Frequency Selection
- Current Injection
- Noise Filtering

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### EXPERIMENTAL DETAILS AND RESULTS

- 5 male subjects, 3 different positions
  - \[ \text{\textit{Injected current}} \in [2, 10, 50, 100] \text{kHz} \]

Equivalent circuit of the body and current flow [4]

S - Subject

Reasonable error due to hands shaking!

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### CONCLUSIONS

- Real-time ICG/ECG signals acquisition
- Touch-based portable ultra-low power device
- Correlated with the traditional setup (> 80%)

### REFERENCES: