



Beth Israel Deaconess  
Medical Center



A teaching hospital of  
Harvard Medical School

# Workshop

## Non-invasive measures of mood, anxiety, and sleep behavior

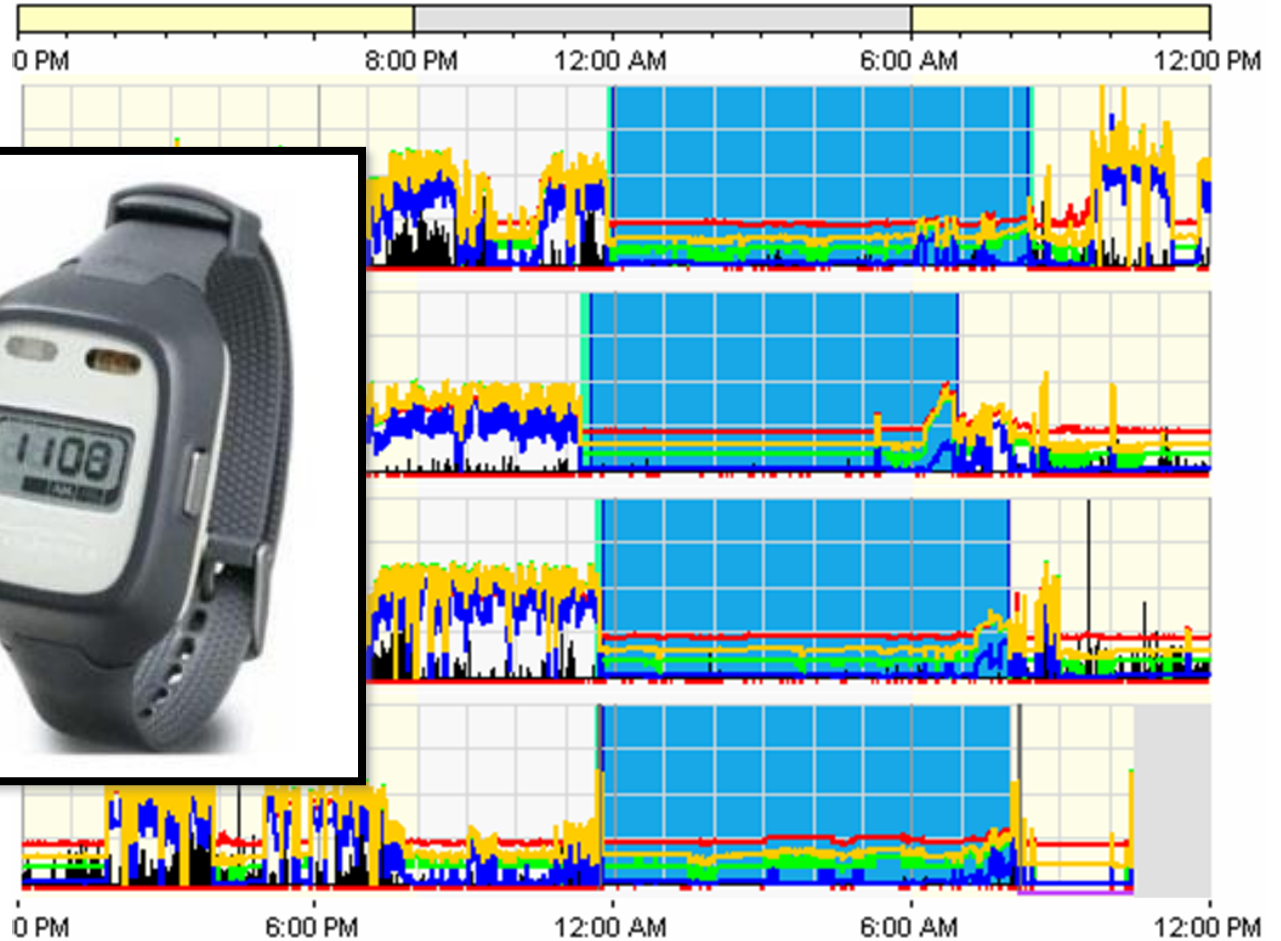
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# Non-invasive Monitoring of Sleep

- EEG
- Cardiorespiratory
- **Actigraphy**
- **Radiofrequency waves**
- **Other techniques**

# Actigraphy



# Wearable Devices



# **Sensitivity and Specificity of Actigraphy**

- High sensitivity (sleep detection): 90-97%
- Low specificity (wake detection): 25-60%

# Applications of Actigraphy

- Sleep/circadian patterns
- Activity monitoring in obesity research
- Scratching behavior in children with atopic dermatitis
- Movement in ADHD research
- Safety monitoring in the elderly
- Sprint speeds in football and soccer
- Tonic-clonic seizure detection
- Gait analysis and tremor in Parkinson's Disease movement

# Combine **Cardiopulmonary** and **Actigraphy** Measures

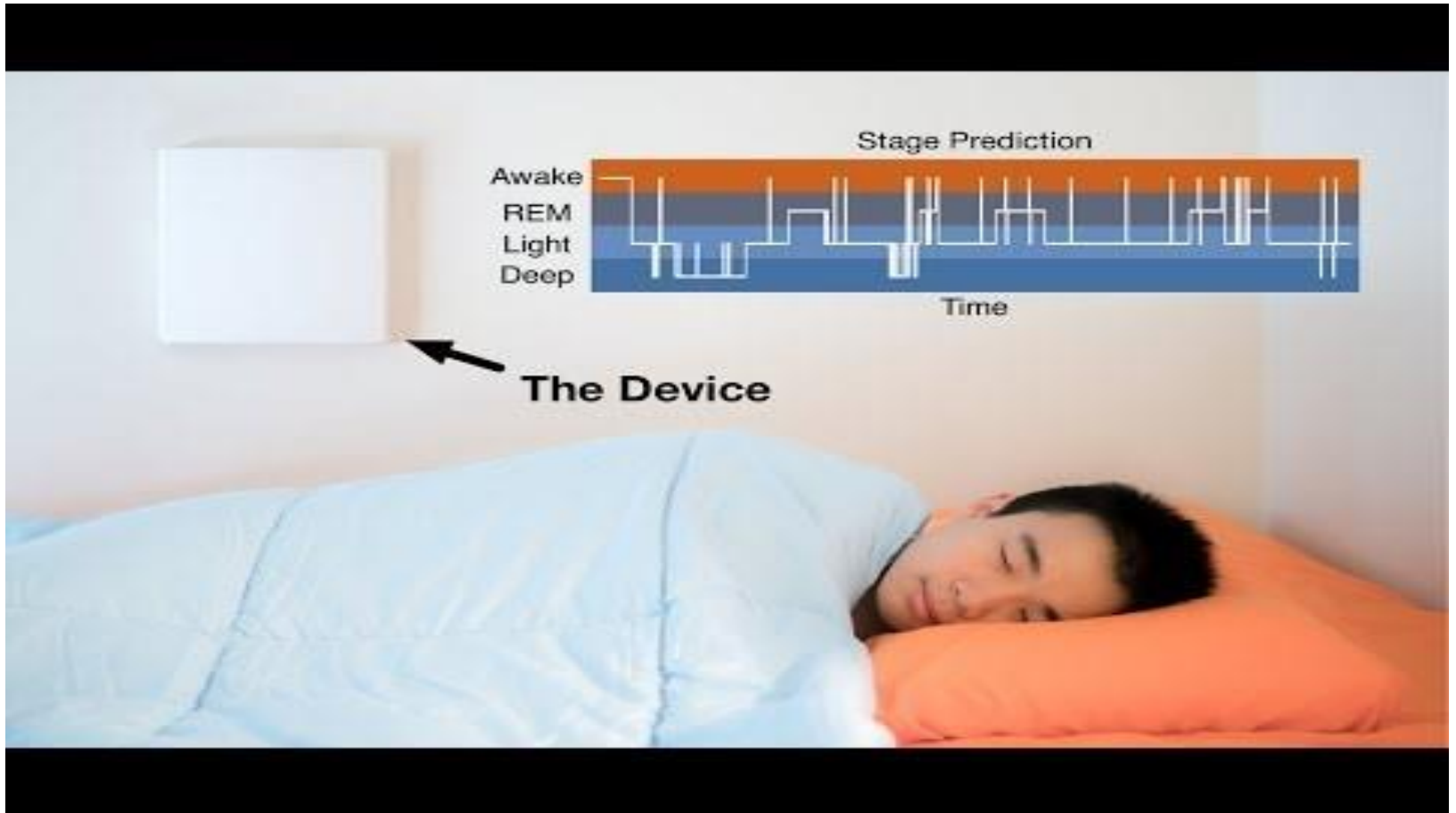
- Cardiopulmonary
  - Wake/REM vs. Sleep
  - Stable/unstable NREM sleep
- Actigraphy
  - Wake vs. Sleep (REM/NREM)

# Radiofrequency Waves

- Radar Signal
  - ResMed S+
- WIFI
  - <http://sleep.csail.mit.edu/>



# WIFI



# Other Techniques

- Video Magnification
- Facial Expression

# Video Magnification



(a) Input



(b) Magnified



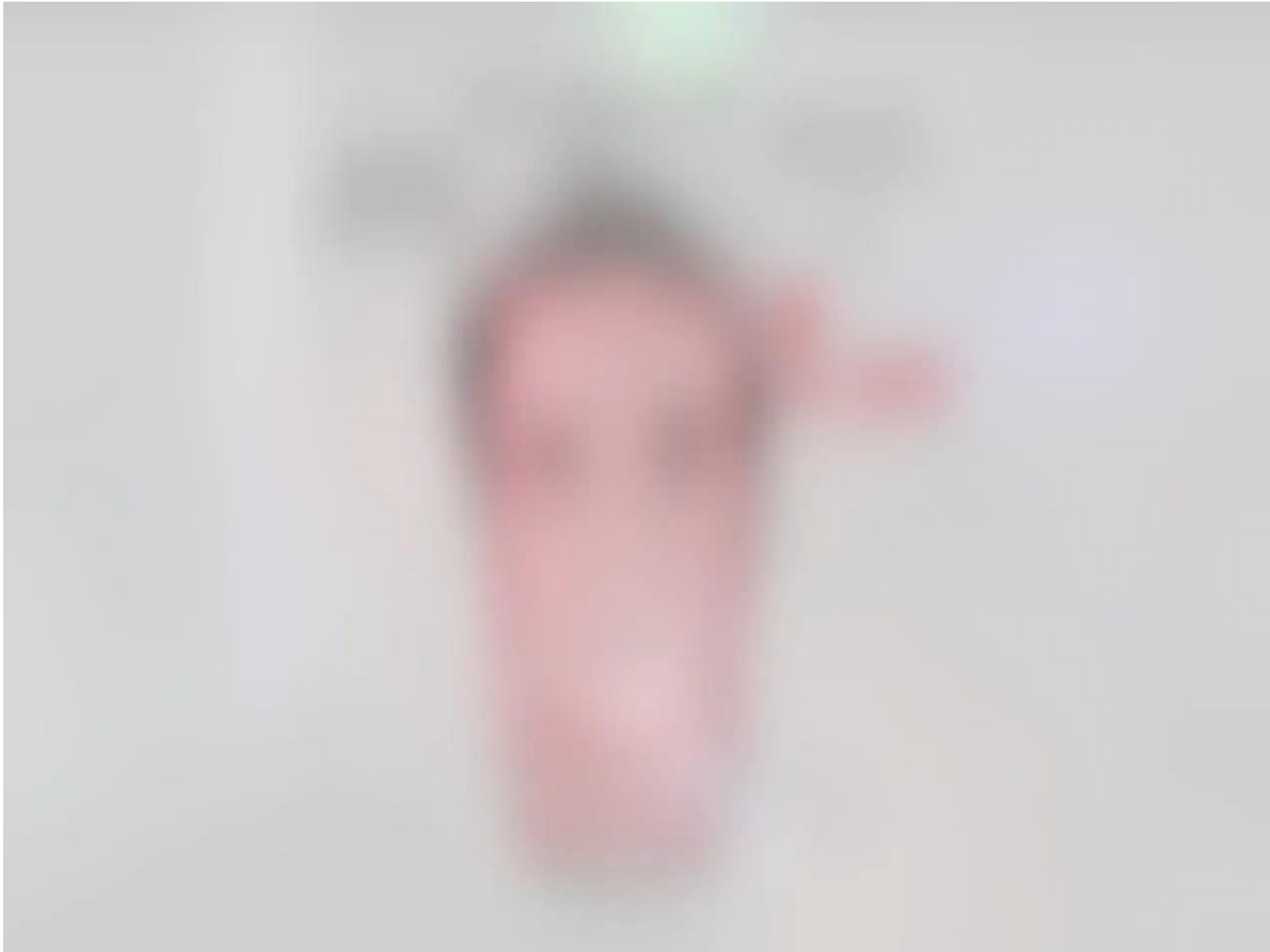
(c) Spatiotemporal  $YT$  slices

# Video Magnification

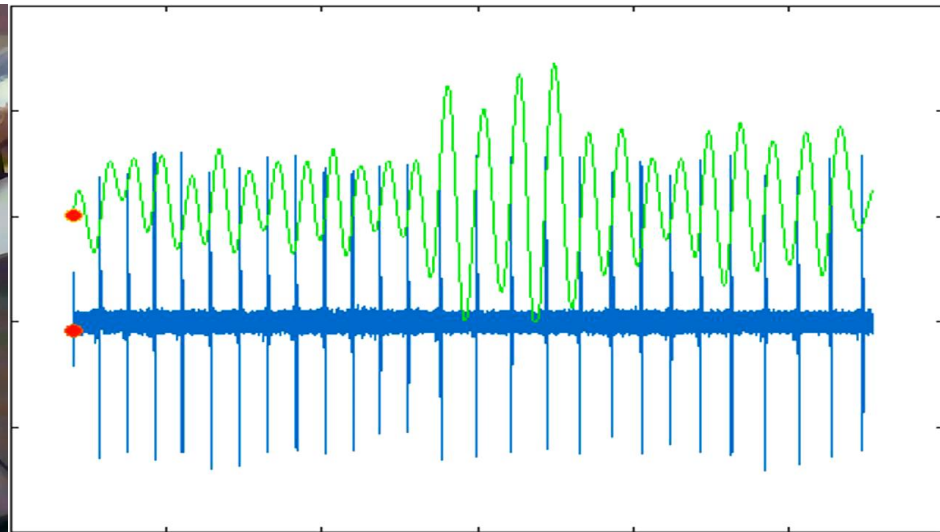
Before  
Magnification

After  
Magnification



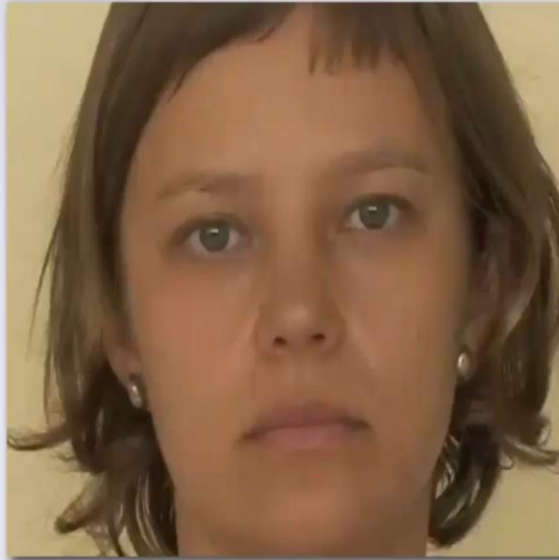


# Measuring **Pulse Rate** From Facial Image Recording



# Micro-expression

**What are Micro Expressions?**



# FaceMood

