

# Analysis and diagnosis of heart sounds using time-frequency analysis

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- A heart problem, known as mitral stenosis, is caused by rheumatic heart disease in the majority of cases, which leads to a narrowing of the mitral valve.
- The objective of this study is to analyze applicability of the S-method in localization of the OS with respect to S2.
- The importance lies in the fact that the OS occurs sometimes very close to the S2, and the physicians are unable to detect it easily.
- The analysis is performed on the heart sounds, recorded at St. Joseph's Hospital in Toronto, Canada, during heart auscultations.

- Considered three time-frequency representations:
  - Spectrogram

$$SPEC(t, \omega) = |STFT(t, \omega)|^2 = \left| \int_{-\infty}^{\infty} f(t + \tau) w(\tau) e^{-j\omega\tau} d\tau \right|^2 \quad (1)$$

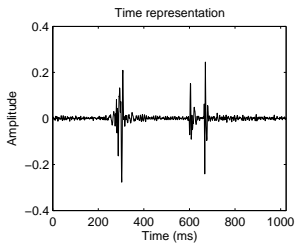
- Wigner distribution

$$W(t, \omega) = \int_{-\infty}^{\infty} f\left(t + \frac{\tau}{2}\right) f^*\left(t - \frac{\tau}{2}\right) e^{-j\omega\tau} d\tau \quad (2)$$

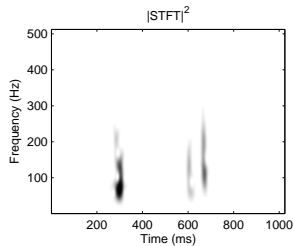
- S-method

$$SM(t, \omega) = \frac{1}{\pi} \int_{-\infty}^{\infty} P(\theta) STFT(t, \omega + \theta) STFT^*(t, \omega - \theta) d\theta \quad (3)$$

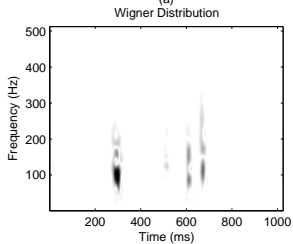
# Results



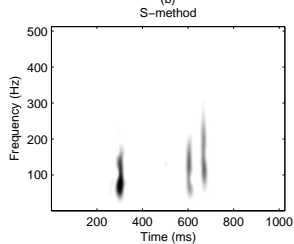
(a)



(b)

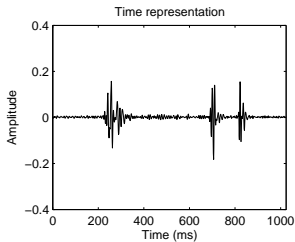


(c)

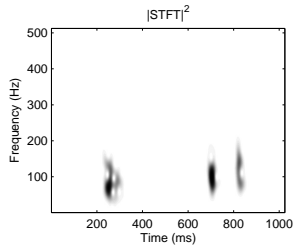


(d)

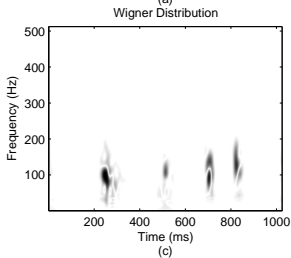
# Results



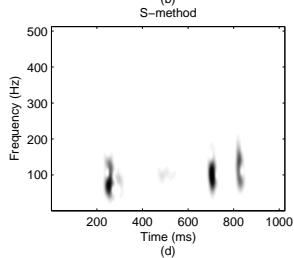
(a)



(b)

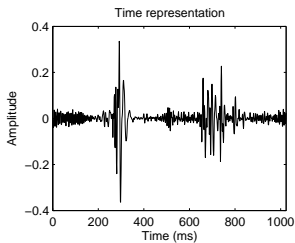


(c)

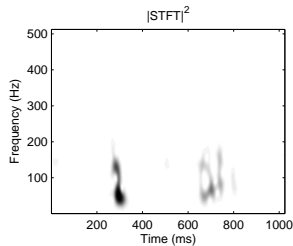


(d)

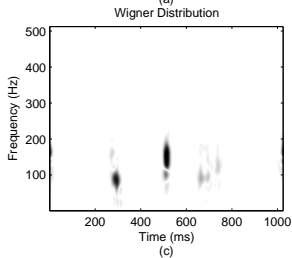
# Results



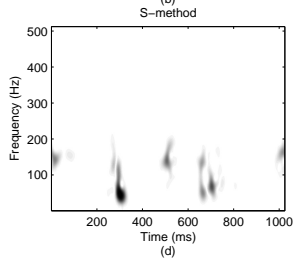
(a)



(b)



(c)



(d)



Thank you for your attention!  
Any questions?