Effects of Shift in Independent Component Analysis

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ICA in Spectral Analysis

- Pharmaceutical Industry
  - Crystallization of active ingredients (Yu et al, 2003)
  - Confirm sample temperature
  - Identify material concentrations
- Medicine
  - MRI *in vivo* analysis (Ladroue et al, 2003)
- Sound/Recording Music Production
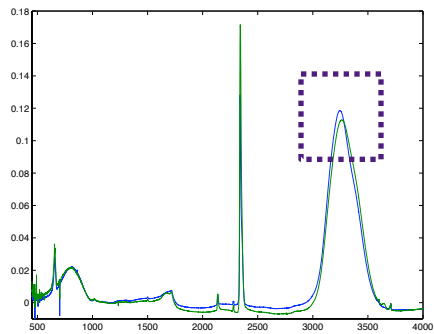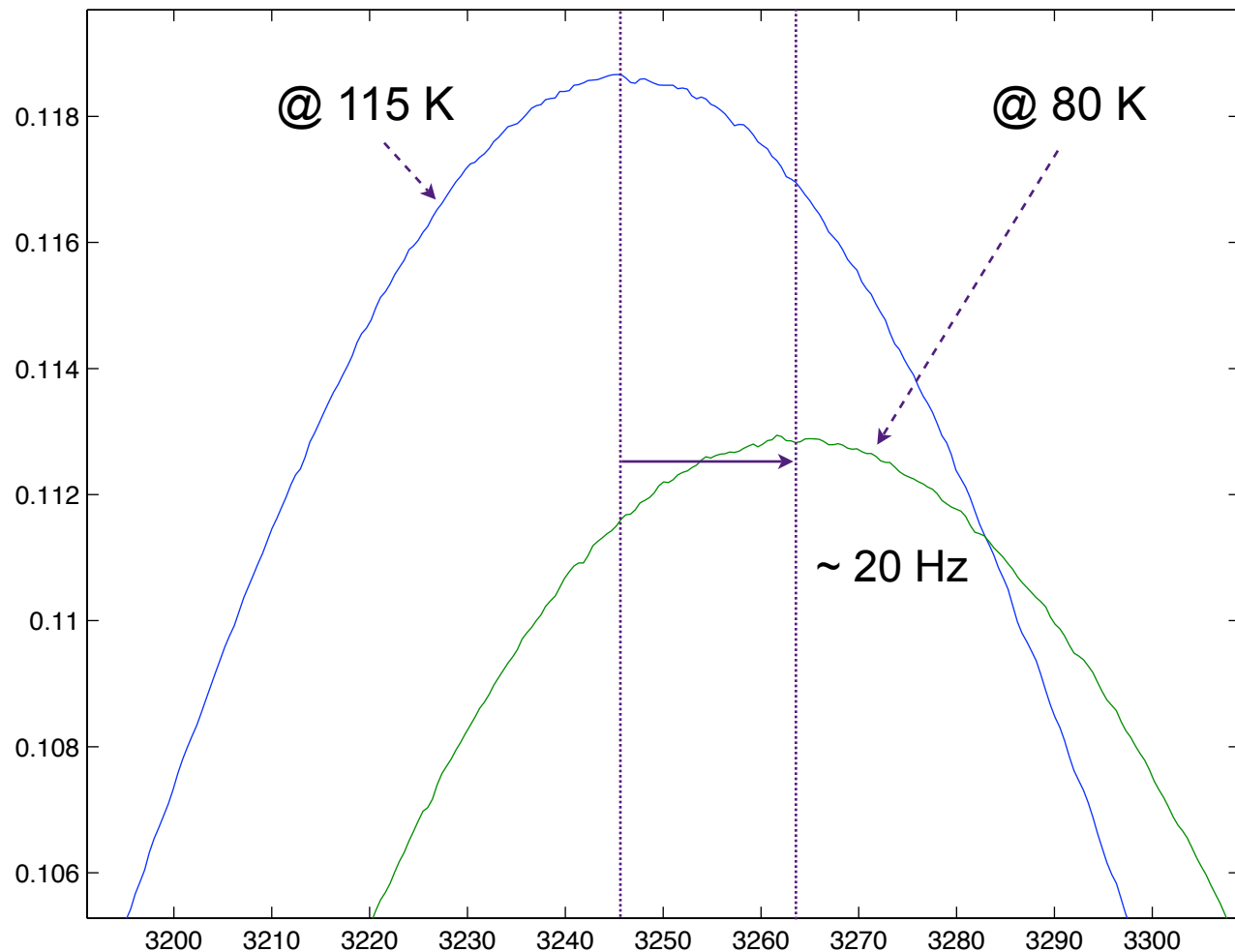 - Watermarking (Malika et al, 2005)

Shift in Spectral Data

- Pharmaceutical Industry / Medicine:
  - Instrument de-calibration
  - External and/or sample temperature
  - Presence of undesired material
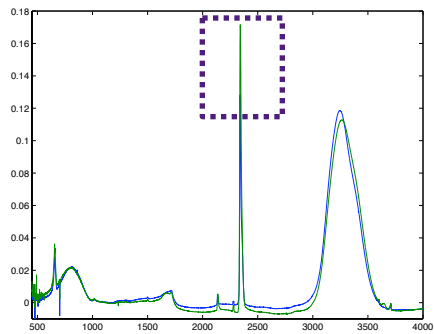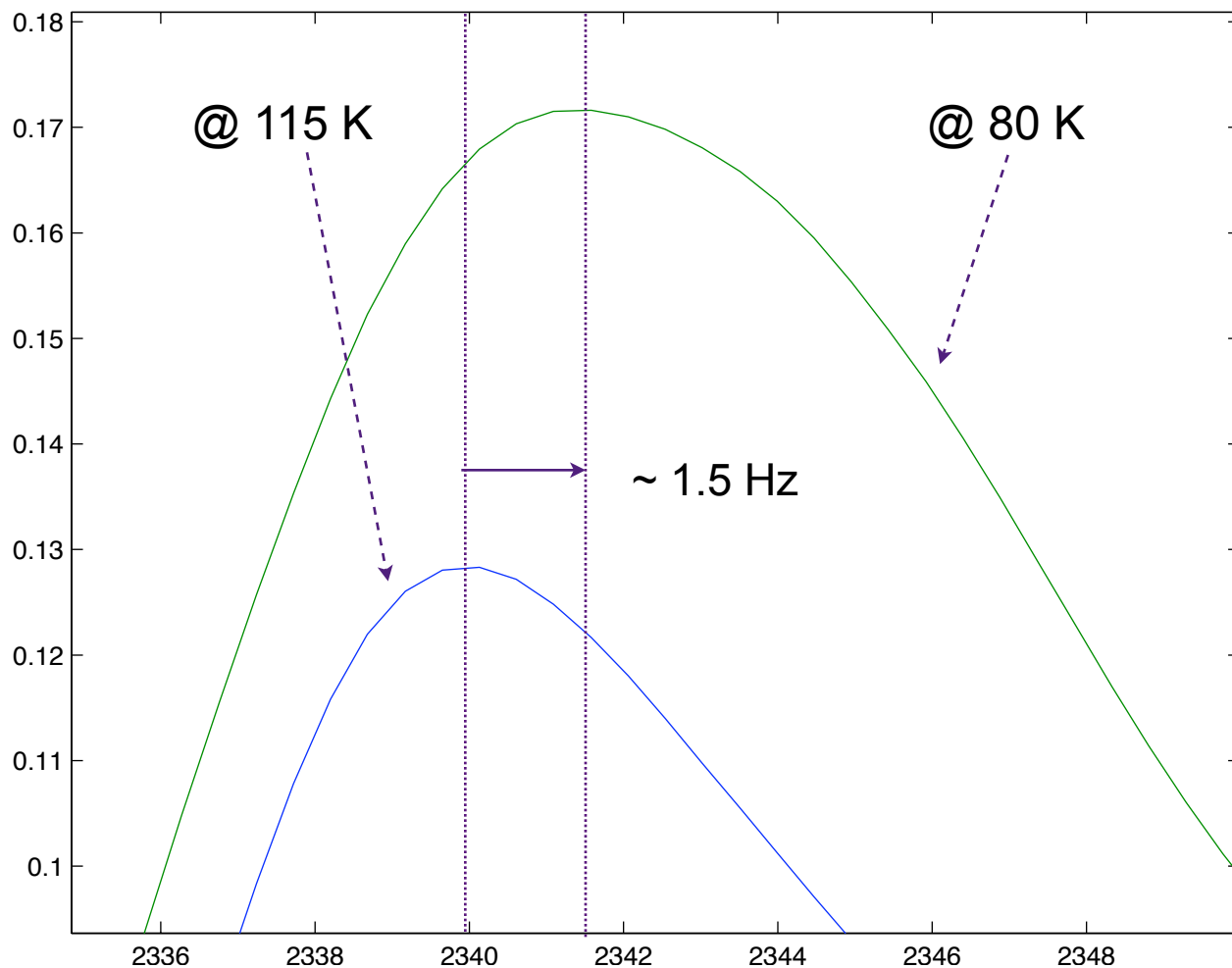- Sound/Recording Music Production:
  - Instrument de-tuning

Shift in Spectral Data
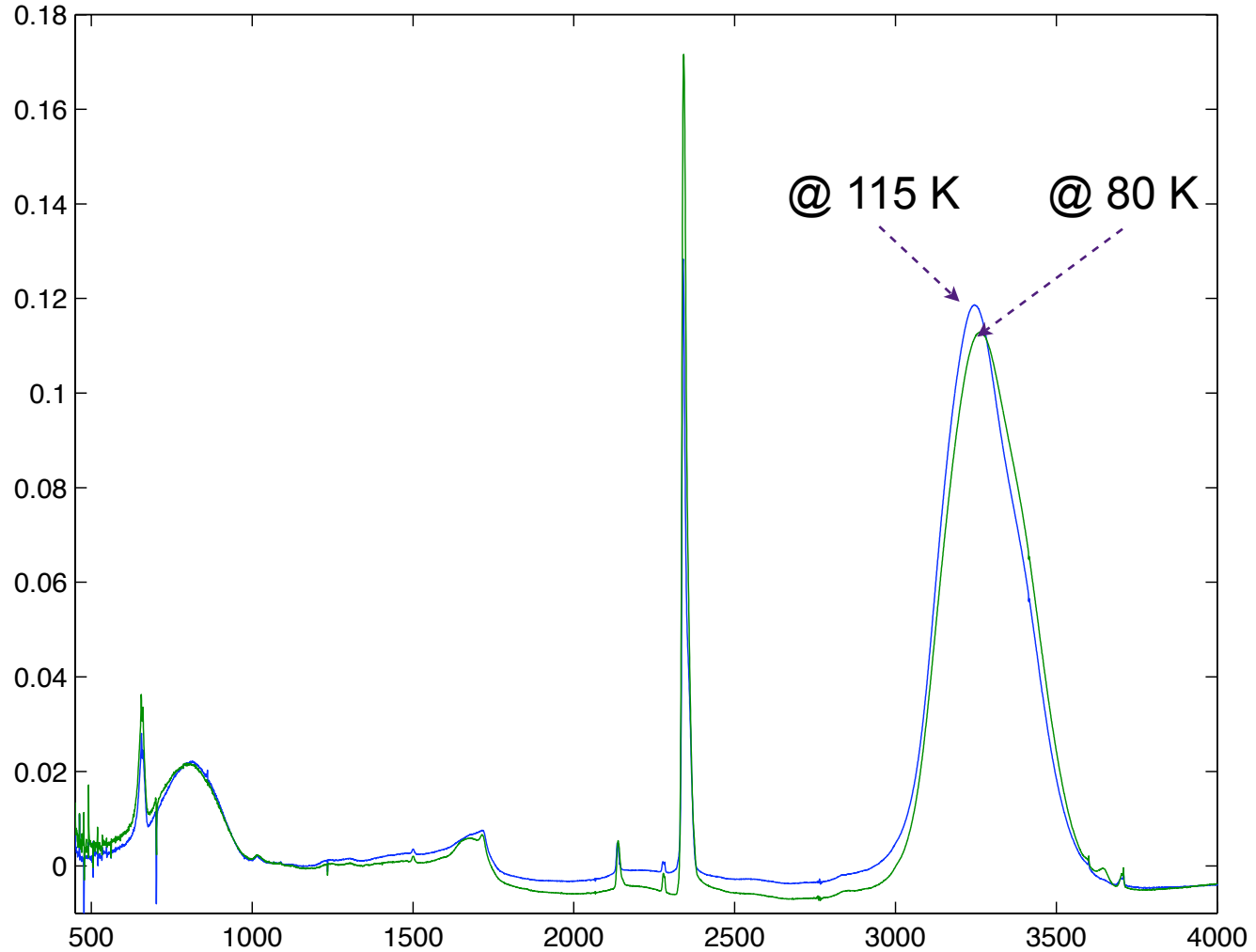
Shift in Spectral Data

# Shift in Spectral Data

Data Alignment and ICA

Actually, and perhaps surprisingly, it turns out that [to solve the IC estimation problem] it is enough to assume that [the sources], **at each time instant t**, are statistically independent.
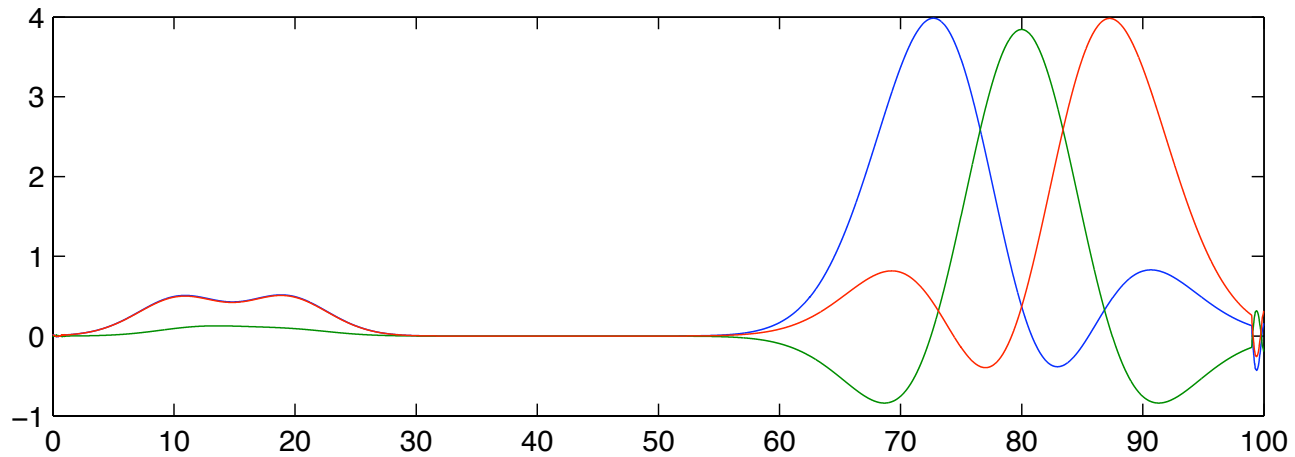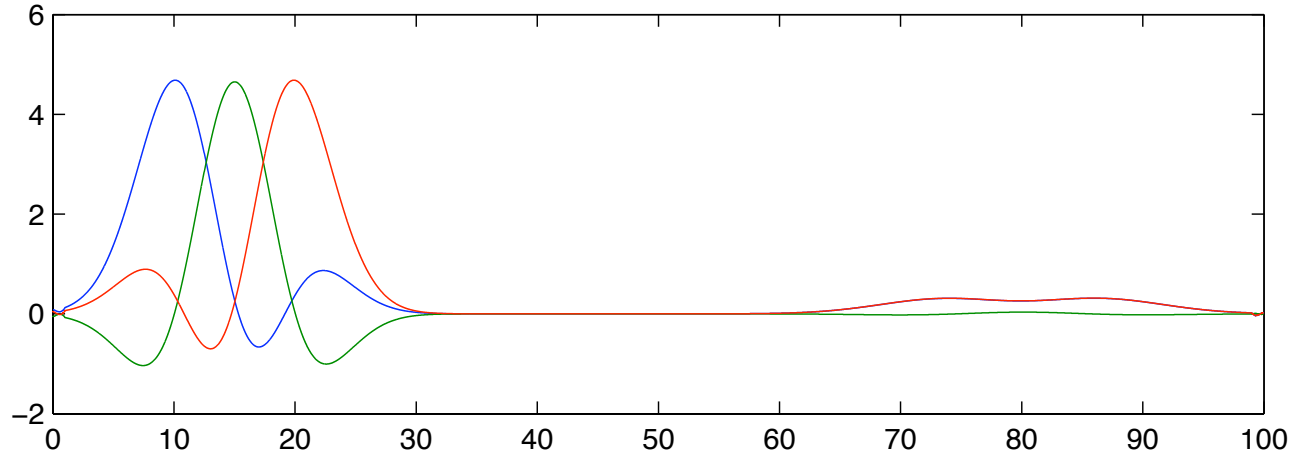
<div align="right">

Hyvärinen et al, 2000

Independent Component Analysis: Algorithm and Applications
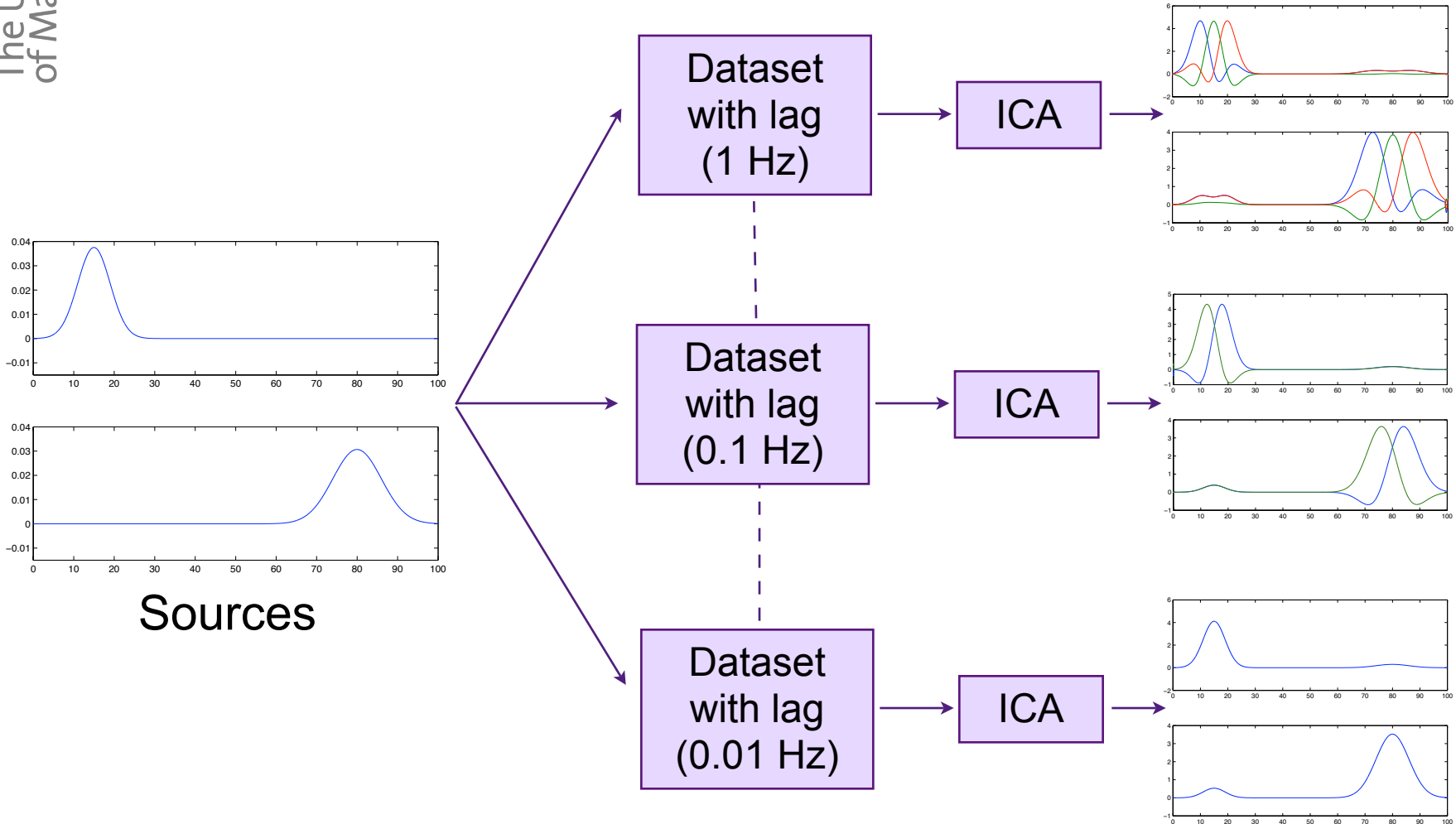
Neural Networks 13(4-5): 411-430
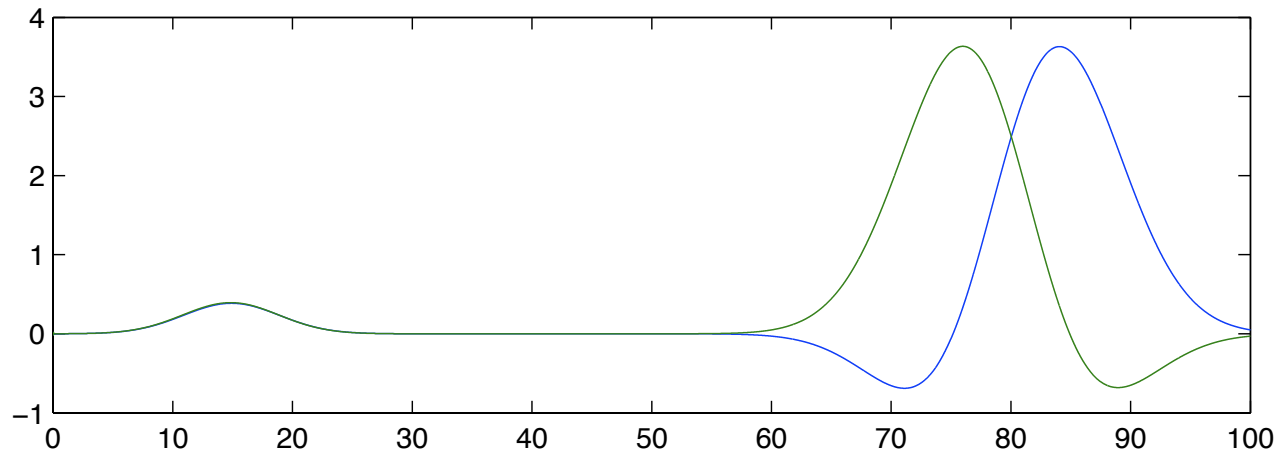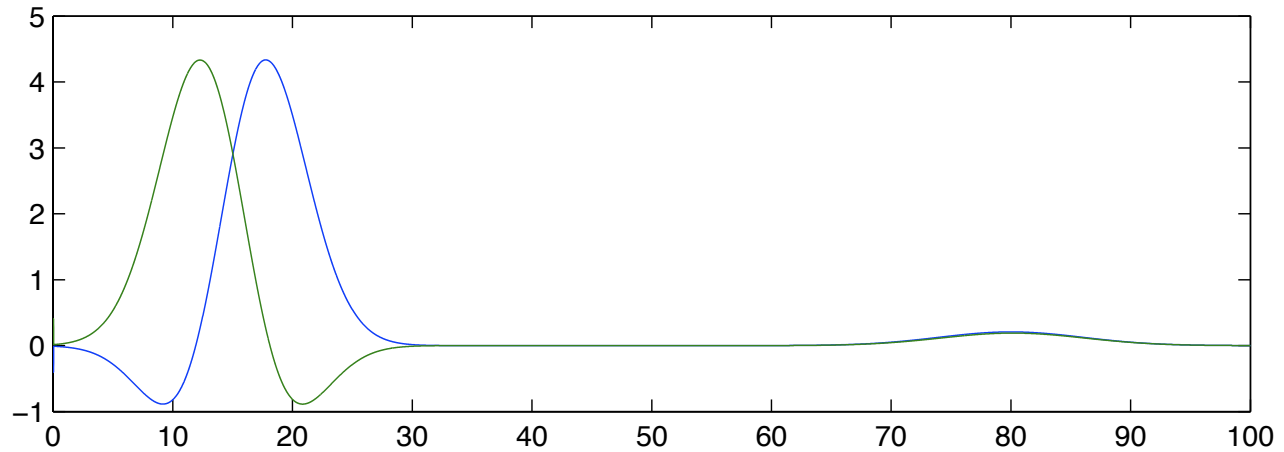
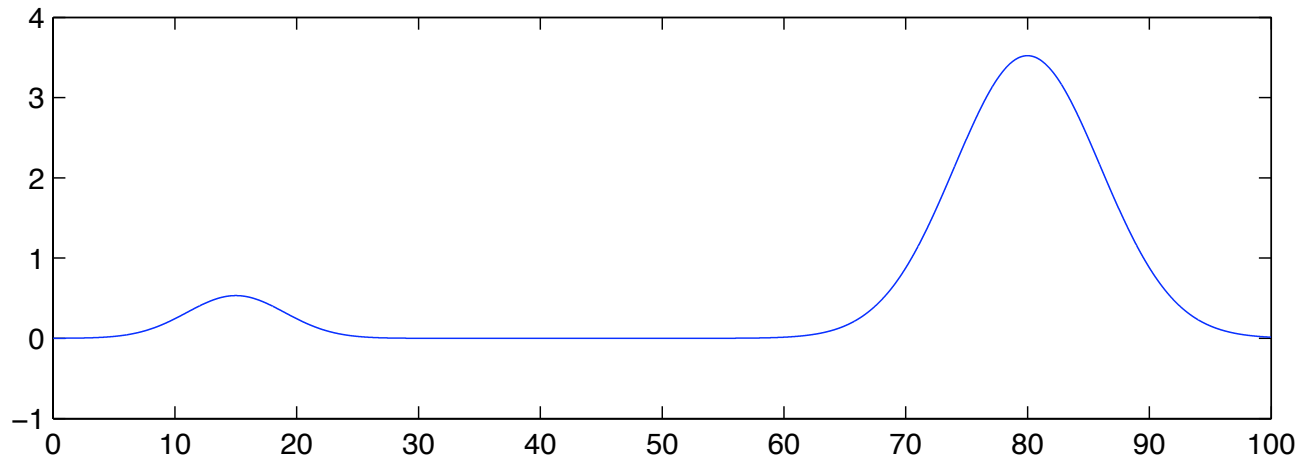</div>

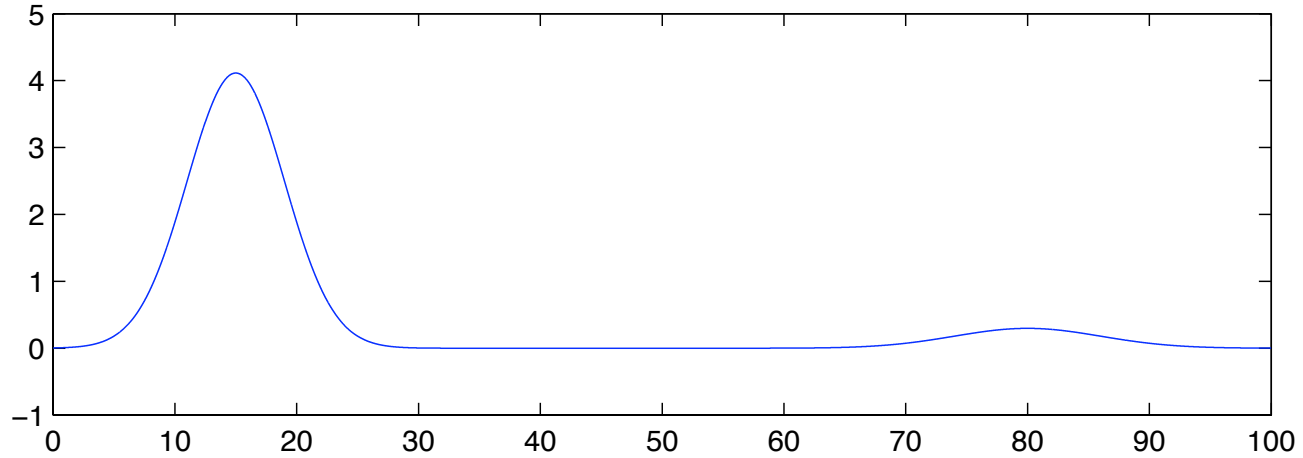# How does Shift affect ICA?
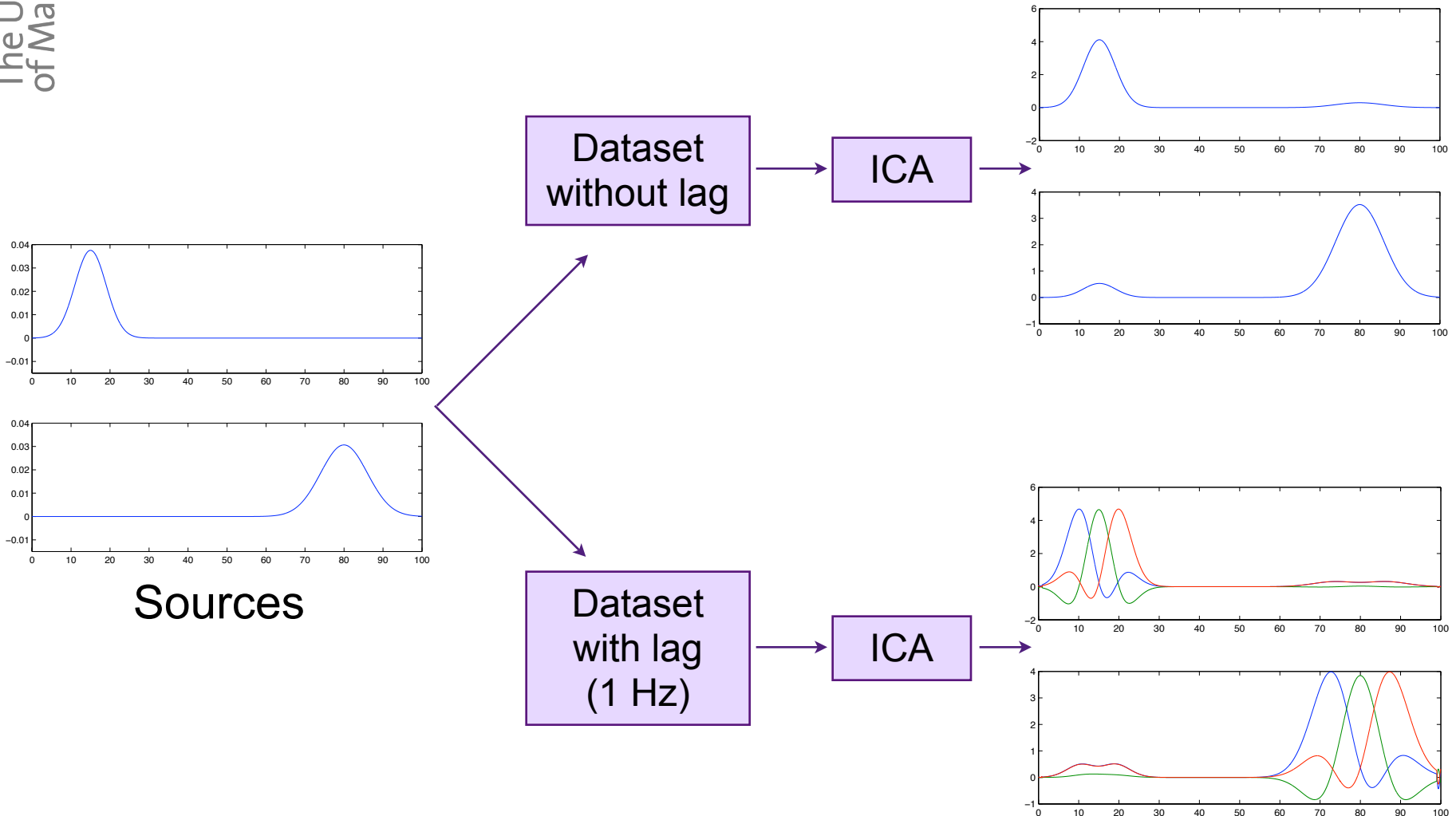
Effects of 1 Hz. Maximum Lag on ICA

How much Shift can ICA handle?

Sources

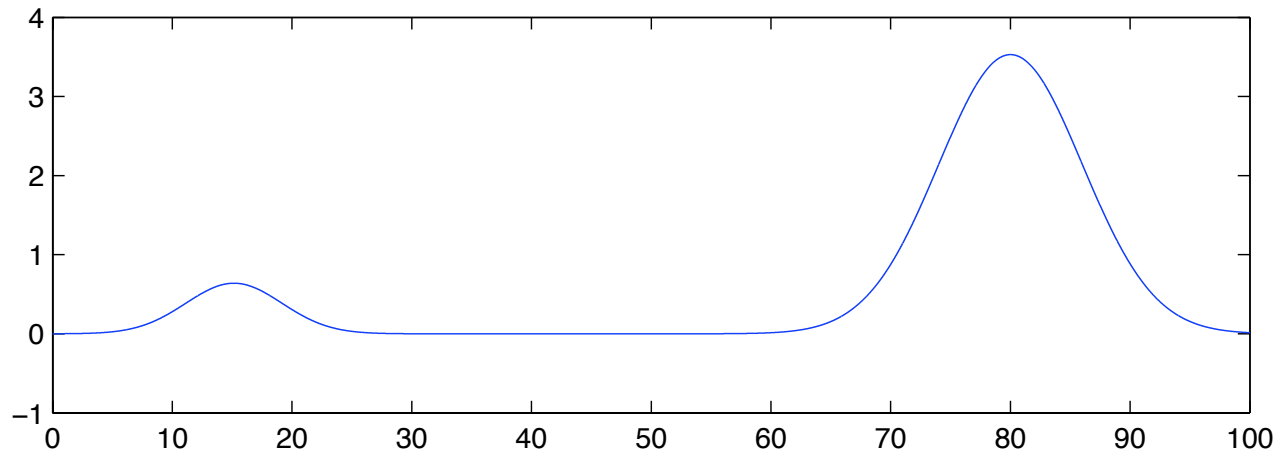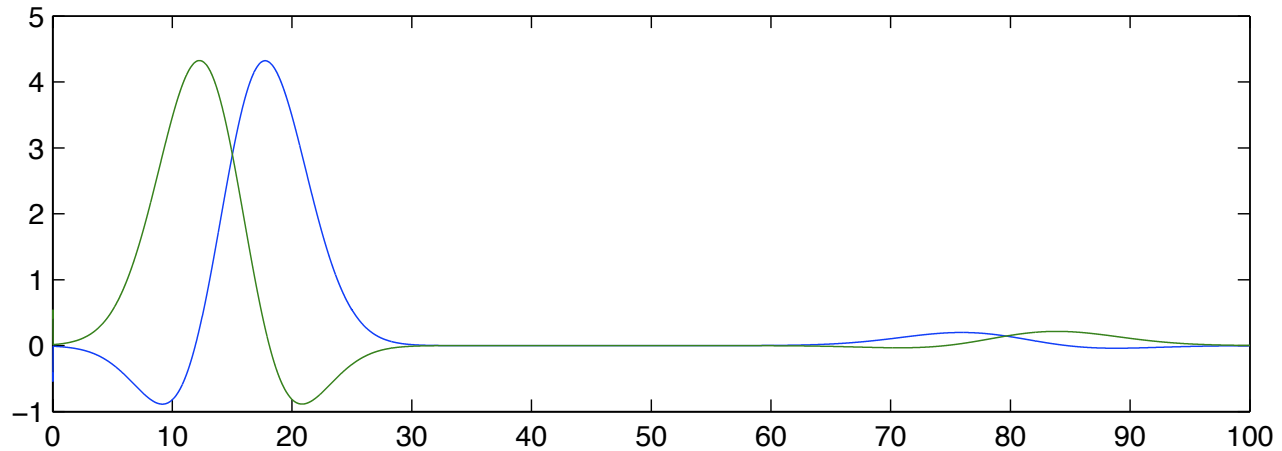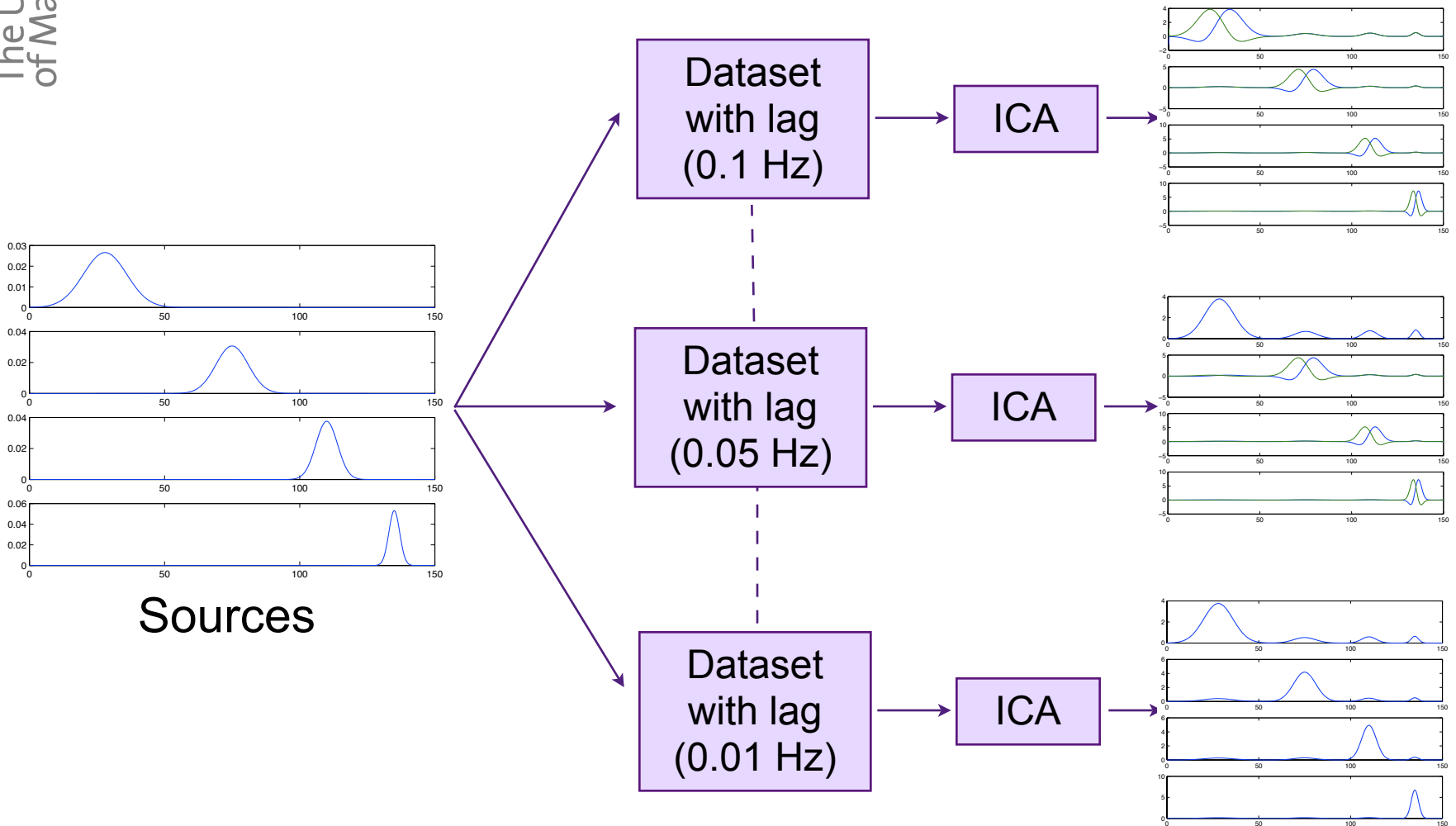# Effects of 0.1 Hz. Maximum Lag on ICA

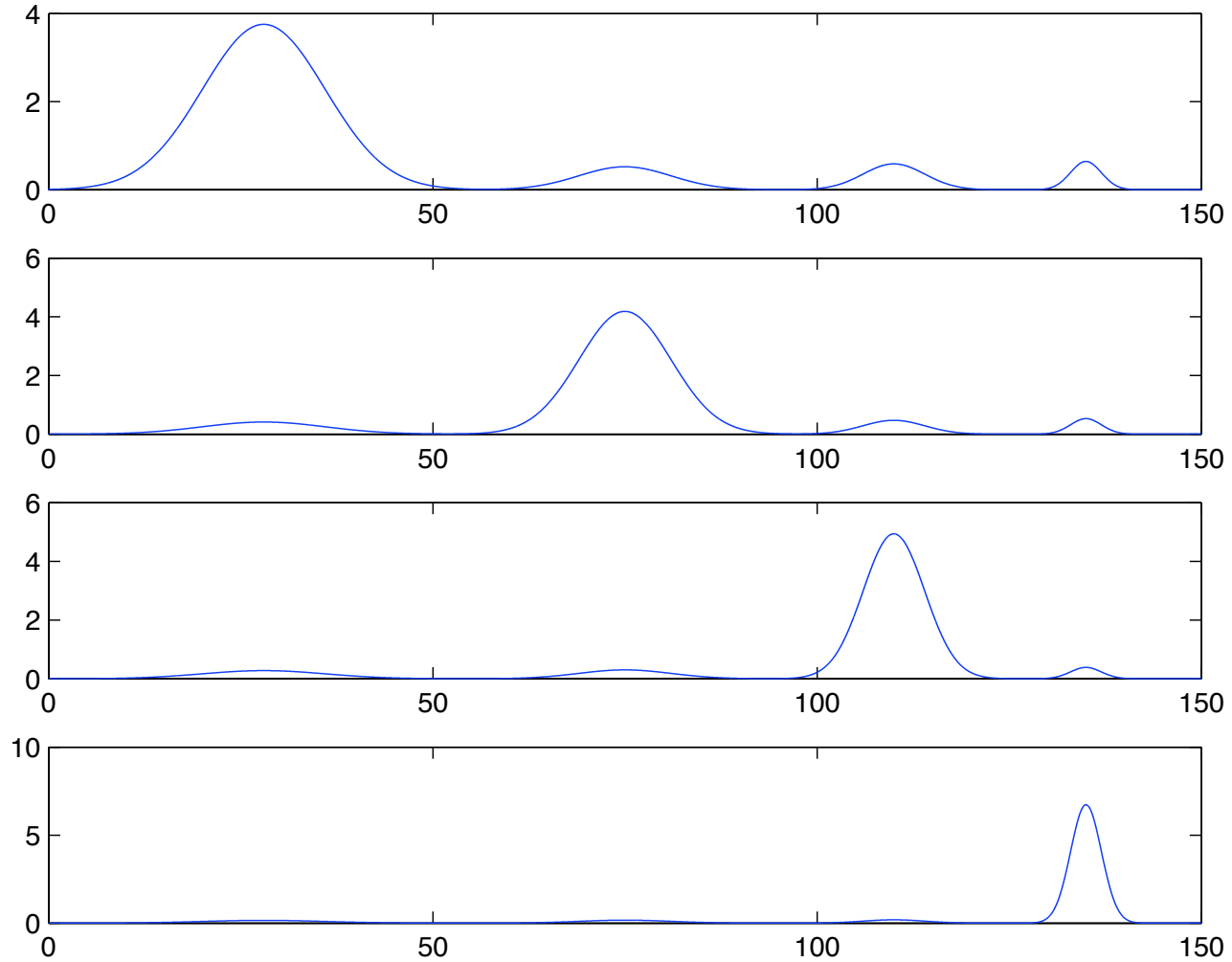# Effects of 0.02 Hz. Maximum Lag on ICA

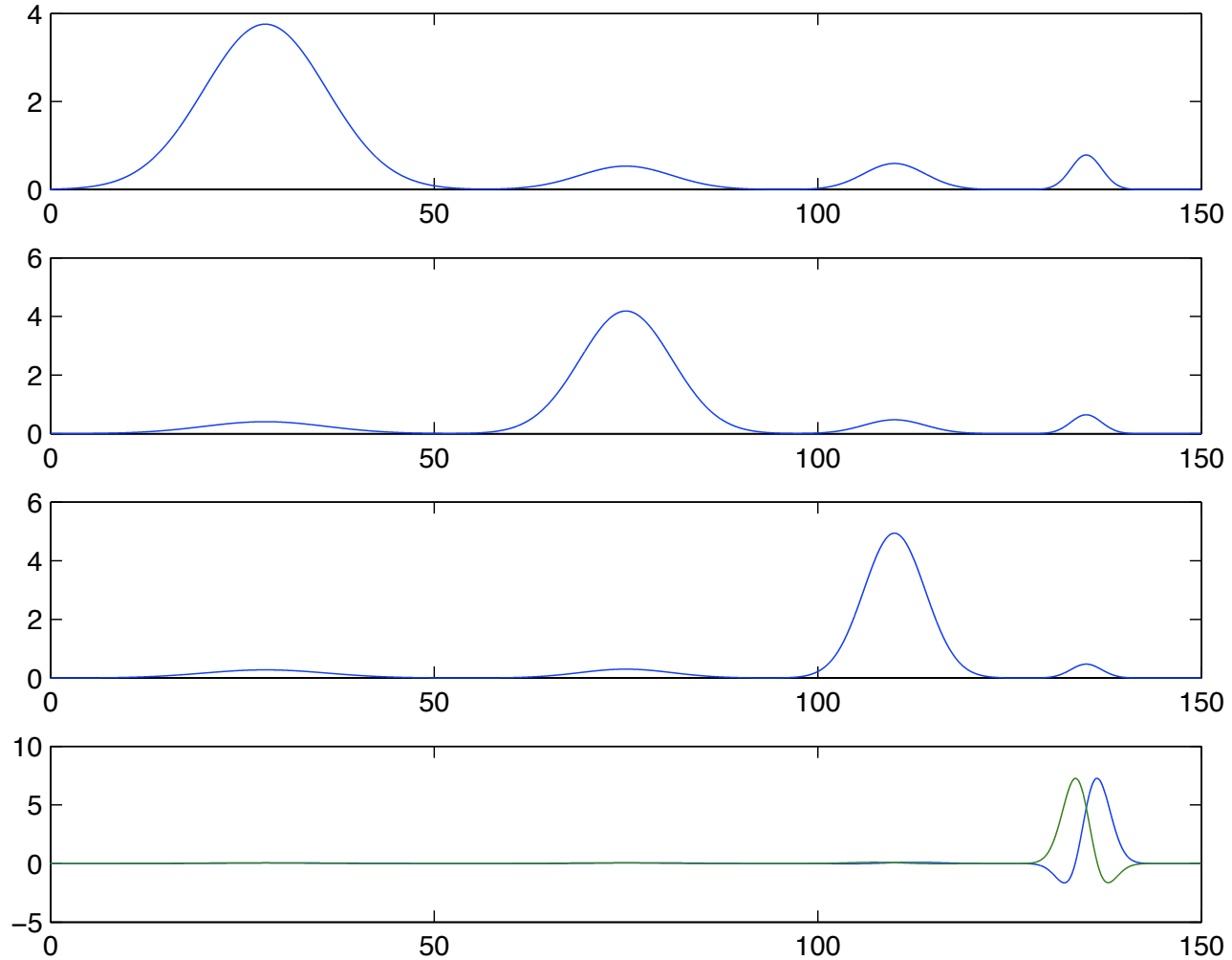# Effects of 0.03 Hz. Maximum Lag on ICA
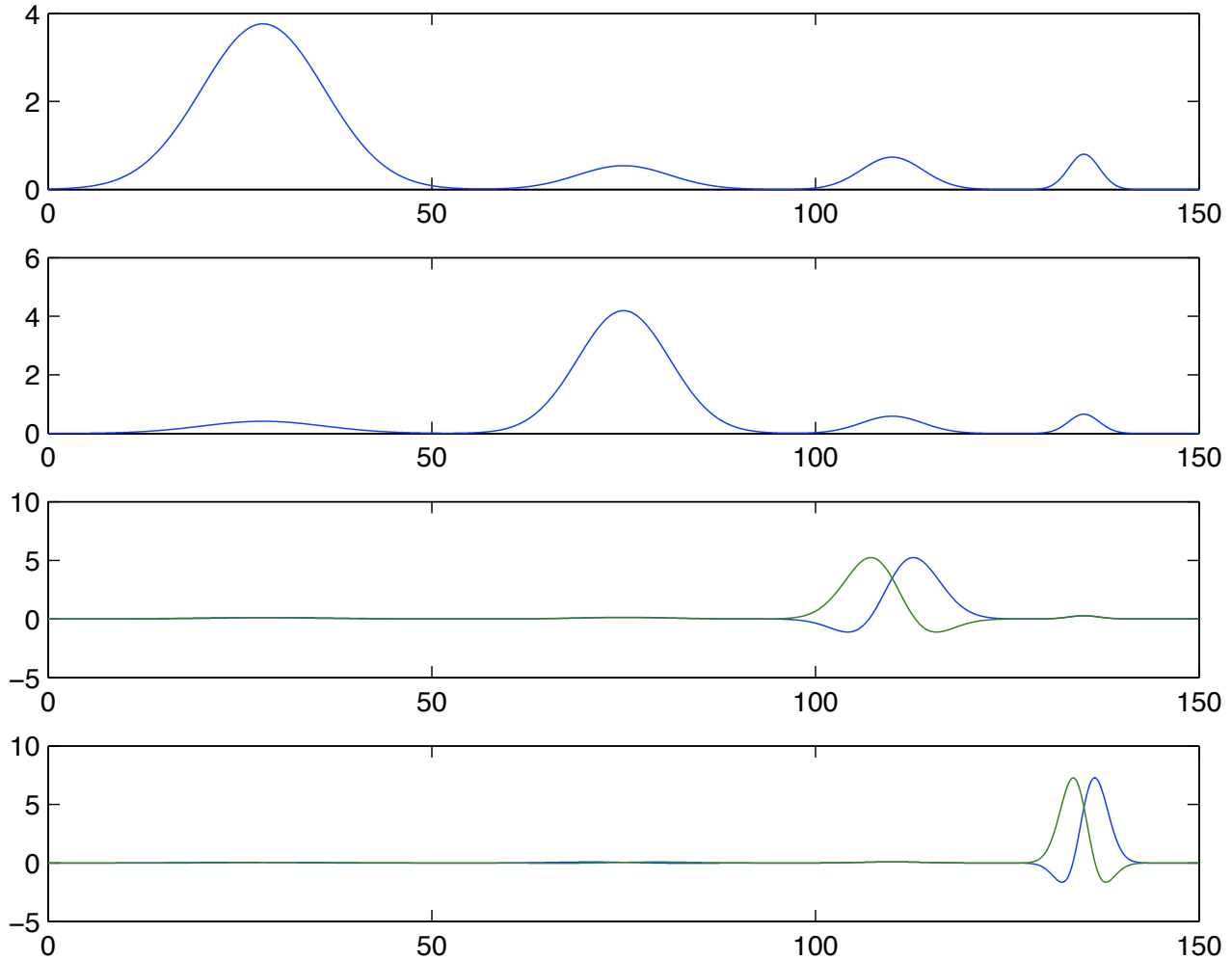
Is Source Width a Factor?

Sources

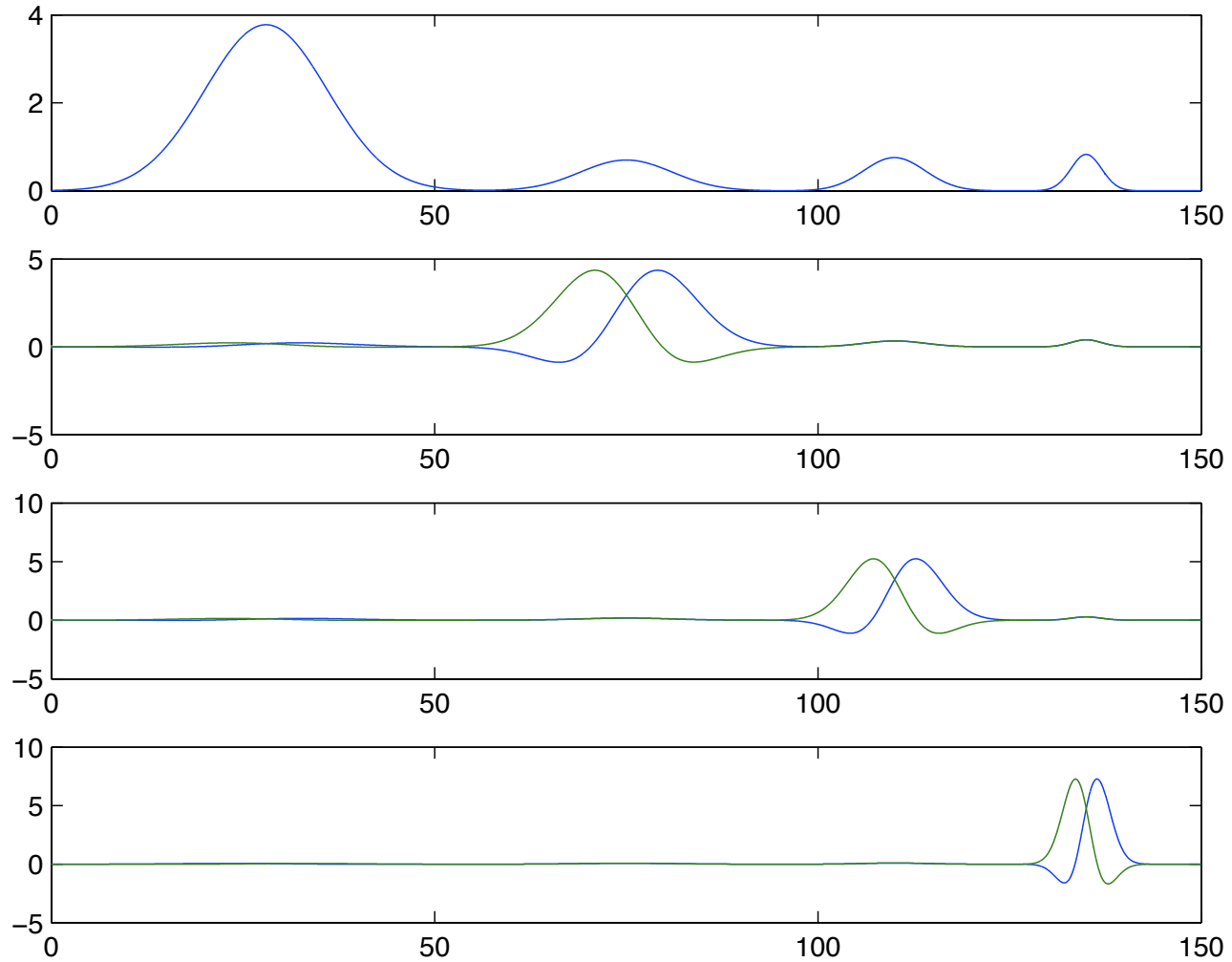# Effects of 0.01 Hz. Maximum Lag on ICA

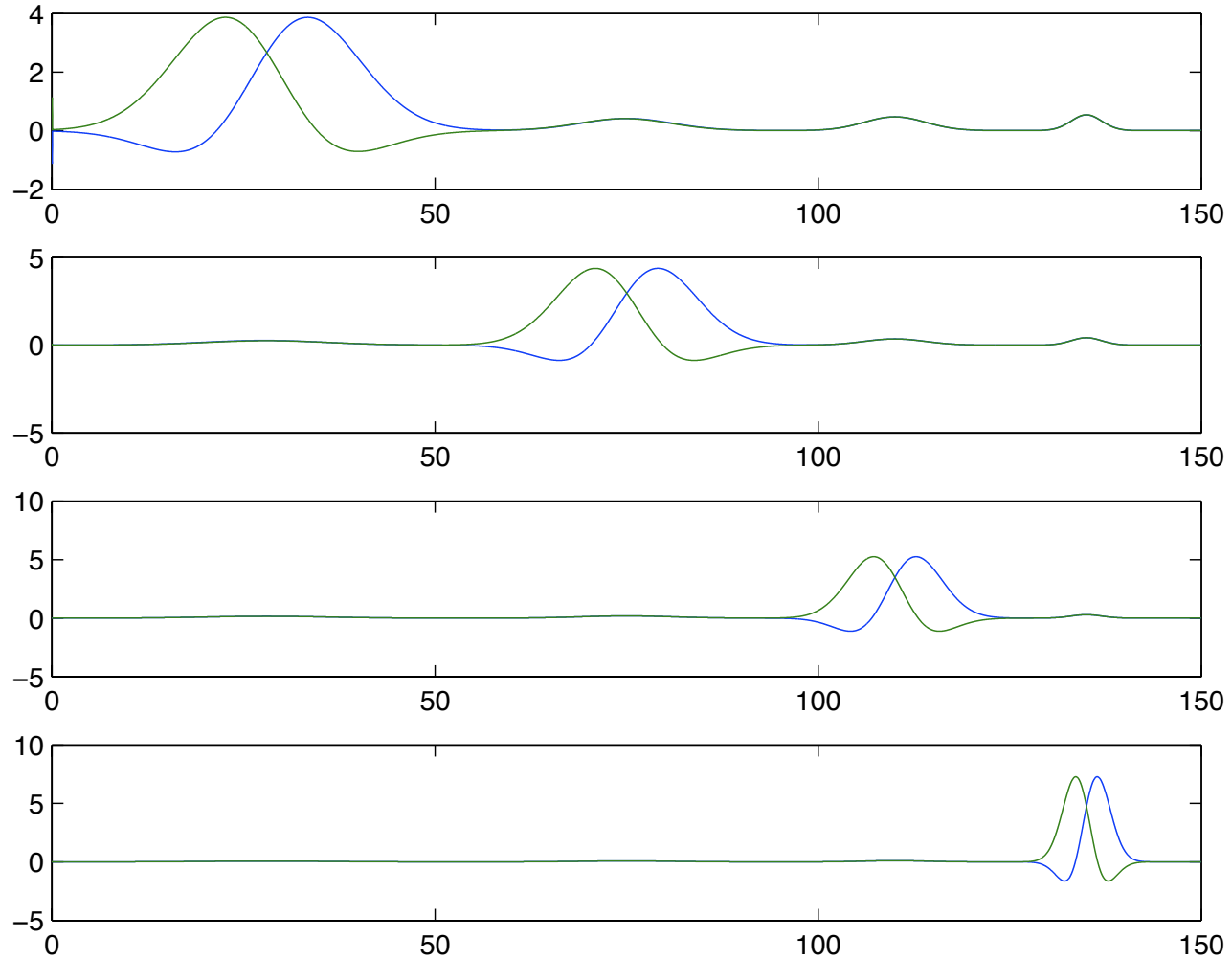# Effects of 0.02 Hz. Maximum Lag on ICA
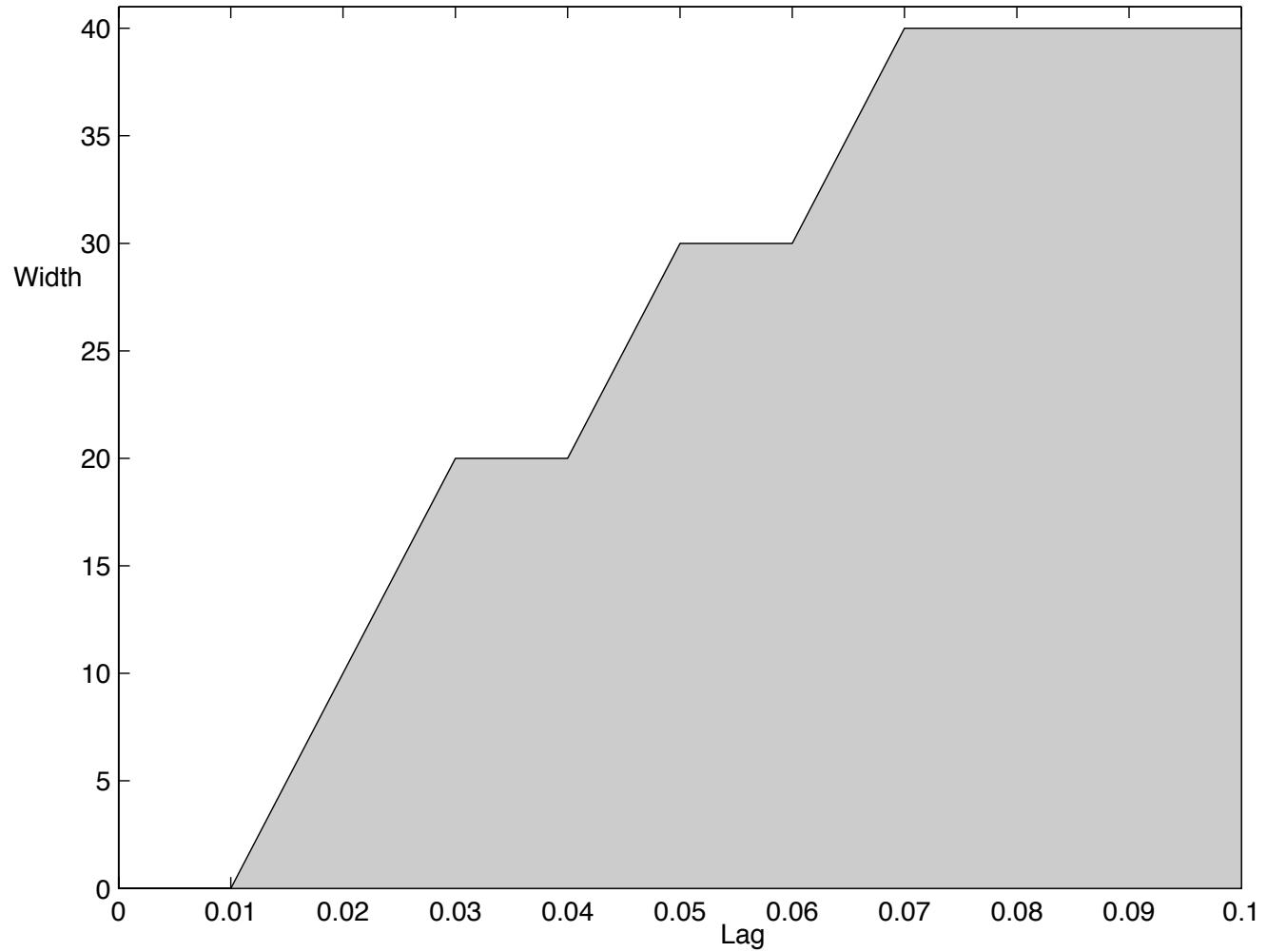
Effects of 0.03-0.04 Hz. Maximum Lag

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Effects of 0.05-0.06 Hz. Maximum Lag

Effects of 0.07-0.1 Hz. Maximum Lag on ICA

Results

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Calibrate?

- Pharmaceutical Industry / Medicine:
  - Costly
  - Protocol based on timetable, not on actual requirement
- Sound
  - Perfect tuning not viable

Conclusions

- Spectral shift is very common in various scientific and industrial areas
  - Shift does not affect spectral consistently
  - Components may shift differently from each other
- With ICA, estimates differ considerably when data suffers from shift
- ICA can handle small amounts of shift, depending on component width.
  - However, it is negligible.

- Currently working on using estimates from ICA on shifted data to recover sources.