#### Goods, bads and the akwards

#### Harry Lehto hlehto@utu.fi





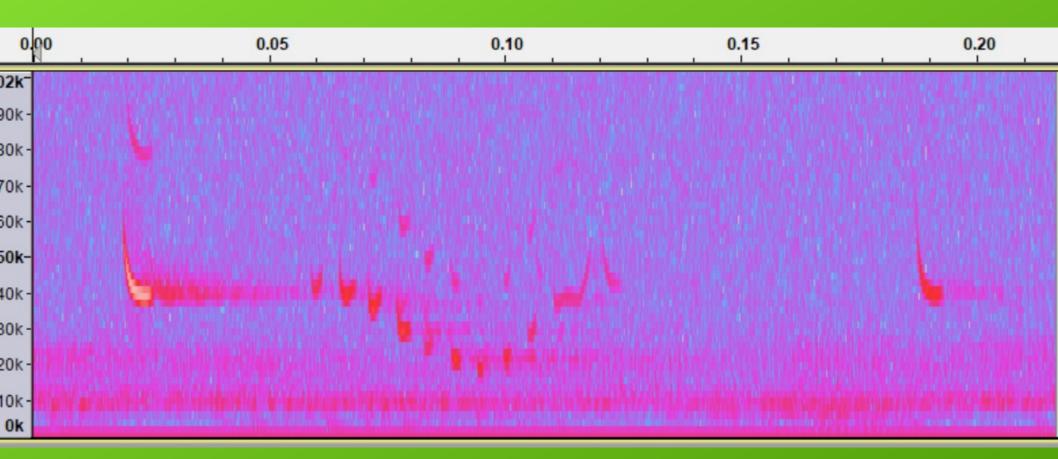
Turun yliopisto University of Turku



# My background

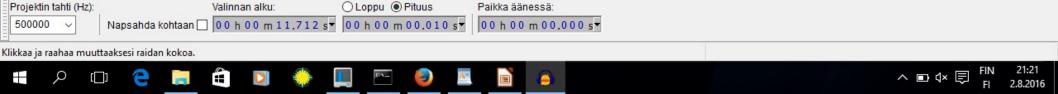
- First Fourier transforms with a TI-58 calculator in 1975
- B.Sc. (Luk) 1980, M.Sc (FM)1982, Ph.D. 1989 (all in Astronomy)
- >100 scientific publications in time series analyses including various FTs & similar methods and their mathematical modelling.
- Since Jun 2006 bird sound recordings. Since May 2007 bat recordings - all full spectrum and good equipment.
- REASON FOR THE TALK quite a few bat people lack the deep understanding of their recordings. Some experienced bat recorders tell that they believe fully in what the fft shows them. They should be more cautious !

### Good

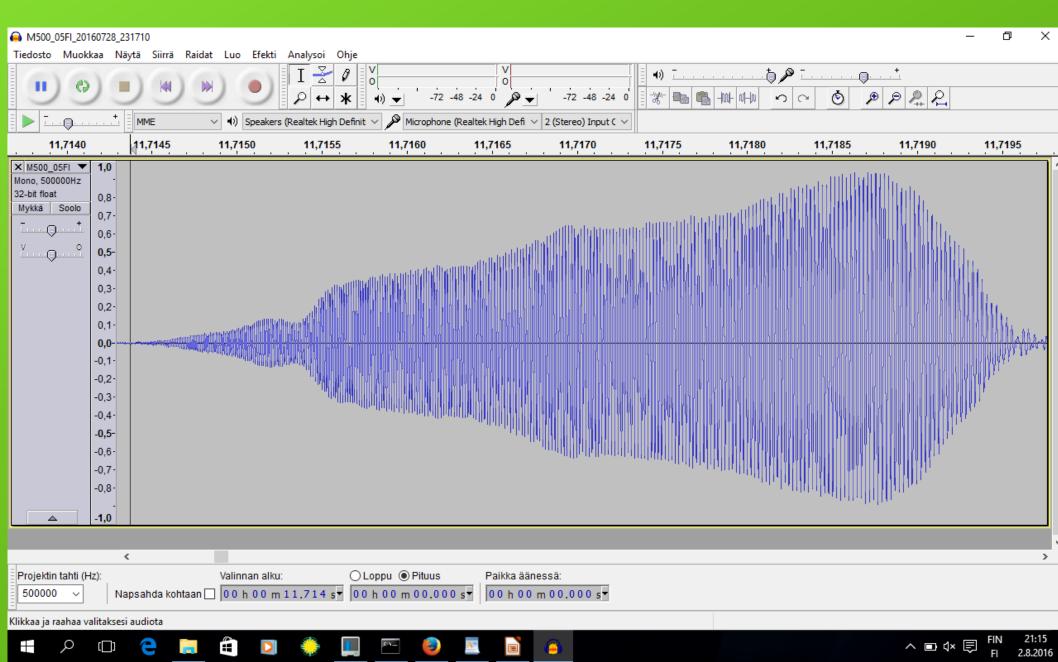


#### Spektrogram, sonogram, sonagram Petterson M500, Myobra/mys

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#### Oscillogram, 5 milliseconds



## Oscillogram 1 millisecond

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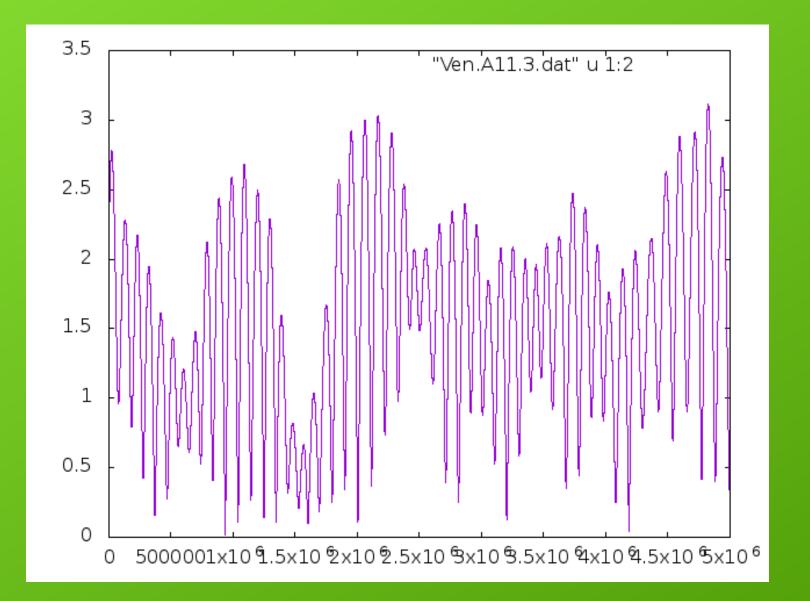
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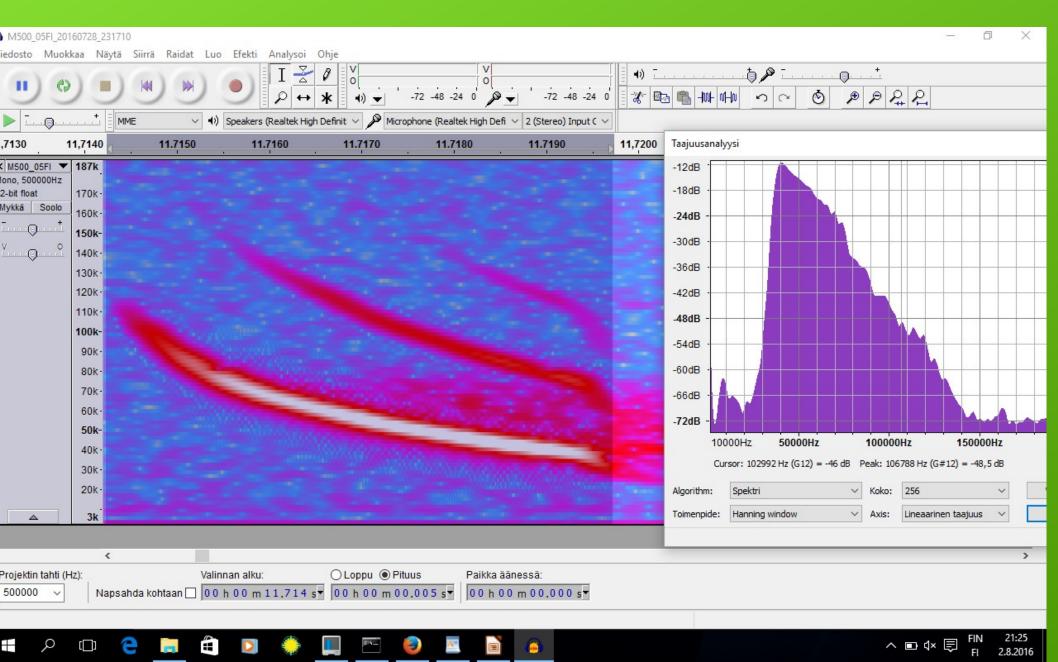
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#### **Tilt of planet Venus' orbit , 5 million years**



#### Related to powerspectrum



# Summary of goods!

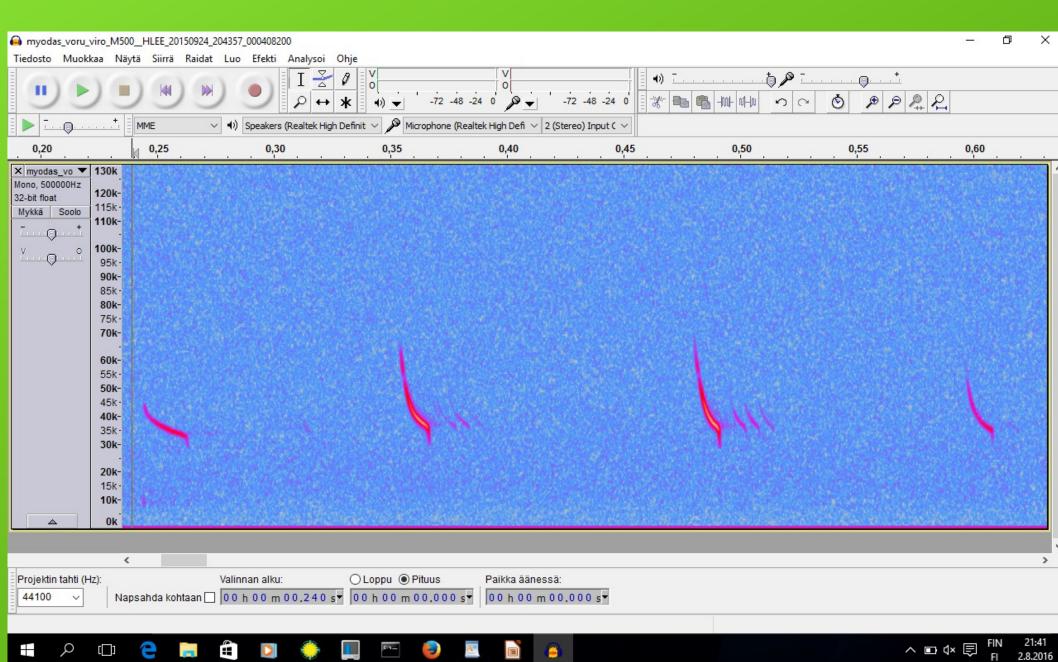
- The Spectrogram is fast to calulate with FFTs (Fast Fourier transforms).
- And convenient with olSTFTs (over lapping Short time Fts). Length of the STFT can be from e.g. 256 to 2028 data points.

# FFT resolution (bad) for sampling of 500 000 KHz $\Delta t \Delta f = 1/2$

FTF	dt	df
2048	4.1msec	0.12kHz
256	0.52msec	1.0KHz

How meaningful is it to express bat sound properties to +-0.1KHz?

#### Dammfladdermus Myotis dasycneme no inteference, because mic at water surface



#### Two sounds ( a 0.3ms shift = 1.0m)

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#### oscillograms (0.3ms shift)

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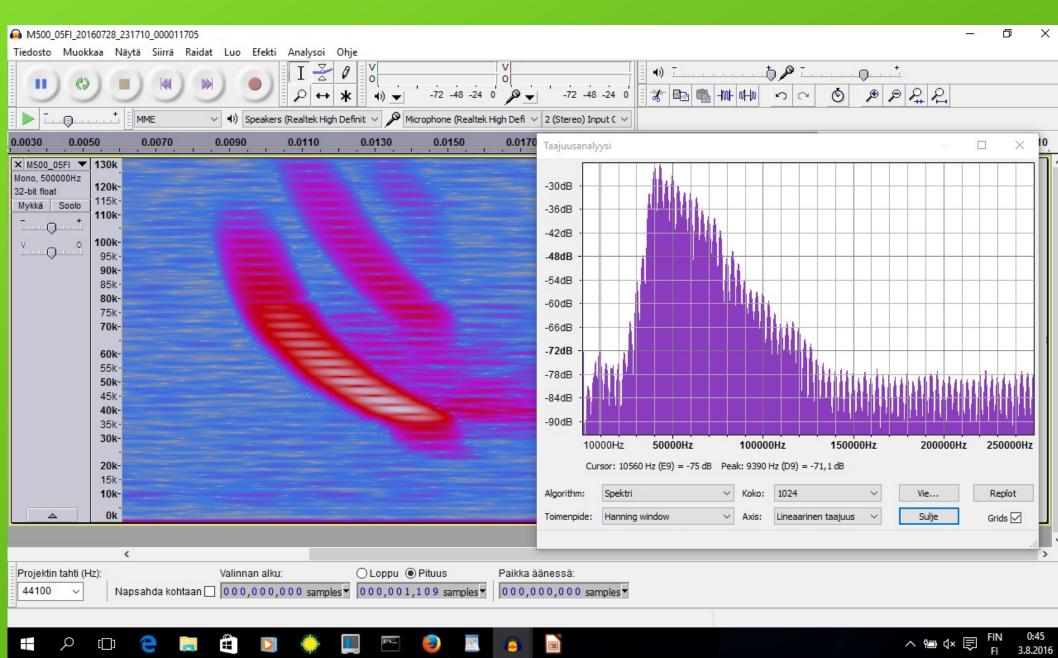
#### Sum of the two sounds

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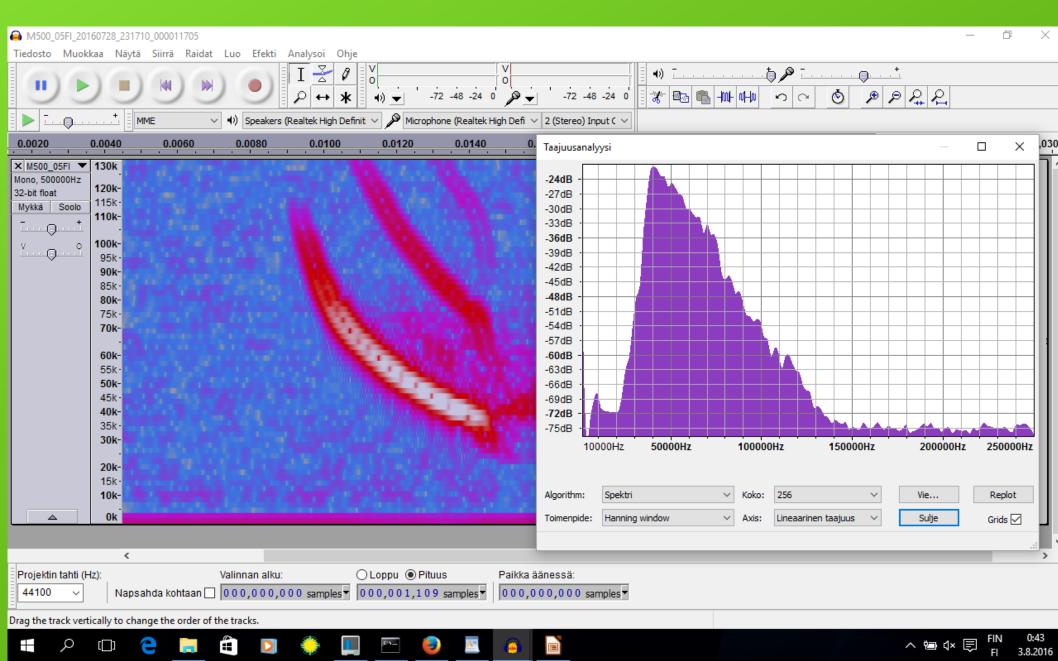
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### Spectrogram long (1024) FFT



#### Spectrogram short (256) FFT



#### Doppler (bigger effectin in kHz at high frequencies) Rhinolophus ferrumequinum, Italia

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#### FT Akwards/outside disturbance

- From FTs
  - Interference, aliasing, harmonics, sharp edges
- Outside disturbance
  - Walking on sand/dirt road, door hinges, Breaking twigs, Keys, clothes
  - Insects (vårtbitare ), tropical frogs, mammals
  - Brathing, wind, rain
- Electronics
  - Car electronics, street lamps, flash powering, image stabilization, autofocus, [ kompaktlysrör(good for checking your detector)]
- Quiet discussion is ok, but avoid loud giggling

# Aliasing, echo, harmonics, highest frequency (Asellia tridens, gambia)

	1.850	1.855	1.860	1.865	1.8
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#### Conclusions

- Fourier-based spectrograms are the best way to identify bat sounds, but note the problems
- Detectors are now reasonably priced (audiomoth, about 100€, not as good as Petterson 200-300€ detectors)

#### • Thank you, tack, kiitos





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