AALBORG UNIVERSITET

Ph.d.-forelæsning/PhD Defense

Som led i betingelserne for opnåelse af ph.d.-graden ved Aalborg Universitet, Det Ingeniør- og Naturvidenskabelige Fakultet, holder Emil Solsbæk Ottosen, Institut for Matematiske Fag, en forelæsning med efterfølgende forsvar af ph.d.-afhandlingen

Sparse Nonstationary Gabor Expansions
with Applications to Music Signals

Hvornår/When?

Fredag den 13. april 2018 kl. 13:00
Friday, April 13, 2018, at 13:00

Hvor/Where?

Aalborg Universitet
Skjernvej 4A, lokale/room 5.018

Tilmelding/Registration

Tilmelding skal ske senest den 3. april 2018 til merete@math.aau.dk,
såfremt du deltager i receptionen.
Deadline April 3rd to merete@math.aau.dk for registration to the reception.

Efter forelæsningen er Institut for Matematiske Fag vært ved en reception, der foregår i kaffestuen (lokale 5.123) på Skjernvej 4A.
After the department will host at small reception at Skjernvej 4A in room 5.123.

På Gensyn til en festlig eftermiddag

Med venlig hilsen

Institut for Matematiske Fag

Department of Mathematical Sciences

Sparse Nonstationary Gabor Expansions
With Applications to Music Signals

By Emil Solsbæk Ottosen

In this PhD thesis we consider sparseness properties of certain adaptive time-frequency representations. Time-frequency representations are two dimensional signal representations containing information about the frequencies of the signal occurring at any given time point. Traditionally, such representations are obtained by dividing the signal into shorter segments and then applying the Fourier transform on each segment. The segments are obtained by multiplying the signal with a smooth window function and the resulting time-frequency resolution depends on the length of this window function. Mathematically speaking, the procedure described above corresponds to a stationary Gabor expansion obtained by decomposing the signal into a convergent sum of time-frequency localized atoms.

A straightforward generalization of the theory is to apply multiple window functions in the expansion resulting in so-called nonstationary Gabor expansions. Both stationary and nonstationary Gabor expansions have shown great potential in relation to music signals as they tend to produce sparse time-frequency representations. Sparseness of a time-frequency representation is often desirable as the particular characteristics of the signals become easier to identify. The sparseness property also allows for efficient approximations of the signal by thresholding the expansion coefficients.

In this thesis we use a very general class of smoothness spaces known as decomposition spaces to characterize signals with sparse expansions relative to certain nonstationary Gabor frames. Nonstationary Gabor frames can be implemented in both the time and the frequency domain and we provide a separate characterization for each case. As a practical application of the theory, we construct a new time-stretching algorithm based on nonstationary Gabor frames in the time domain. Time-stretching is the application of modifying the length of a signal without affecting its frequencies.

Bedømmelsesudvalg/Assessment committee:

Professor Horia Cornean, Aalborg Universitet
Lektor Jakob Lemvig, Danmarks Tekniske Universitet
Professor Hans G- Feichtinger, University of Vienna

Ordstyrer/Moderator:

Institutleder Søren Højsgaard

Vejledere/Supervisors:

Professor Morten Nielsen, Aalborg Universitet