Vetenskapsrådet

Application

2015-03-31

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Information about application

Call name: Forskningsbidrag Stora utlysningen 2015 (Naturvetenskap och teknikvetenskap)

Type of grant: Projektbidrag

Focus: Fri

Subject area:

Project title (english): Tailored Time-Frequency Features for Robust Classification

Project start: 2016-01-01

Project end: 2019-12-31

Review panel applied for: NT-14

Classification code: 20205. Signalbehandling

Keywords: Time-Frequency Analysis, Feature Extraction, Multitaper spectrum

Funds applied for

Year:	2016	2017	2018	2019
Amount:	1,068,000	947,000	1,980,000	2,178,000

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Descriptive data

Project info

Project title (Swedish)*

Skräddarsydda Tids-Frekvensverktyg för Robust Klassificering

Project title (English)*

Tailored Time-Frequency Features for Robust Classification

Abstract (English)*

This work is motivated by the increased use of time-frequency tools in many application areas. Often the interest is to cluster or classify specific time series data of non-stationary and multi-component character. Time-frequency analysis is a natural approach for such data. However, many of the methods used today are not optimal from the choice of time-frequency method, nor from the feature extraction view-point. We intend to focus on to tailor the time-frequency spectra using knowledge from experts and to extract features that are optimal for the specific classification and clustering. Especially two exciting and important areas will be considered, where the character of time- and frequency variations are crucial; 1) medical signals - focusing on classification of the electrical signals from the brain in the context of memory retrieval; 2) sound - especially bird song data focusing on syllable clustering of the great reed warbler song. These applications have in common that the variations inside a class might be very large and that the actual differences between classes might be hidden by other large variations. The novel approach in this project is to include knowledge of the expert comments in the design of optimal methods for the time-frequency spectrum calculation as well as for the extraction of features. State-of-the-art methods will be applied for classification and clustering and the results based on different feature sets will be evaluated and compared to existing methods.

Popular scientific description (Swedish)*

När fåglar kvittrar är ljuden vi hör uppbyggda av många små del-ljud, olika toner. Tonerna kommer efter varandra i tid med lite olika mellanrum och har olika tonhöjd (frekvens). Ett sådant ljud uppbyggt av del-ljud kallas för stavelse. Att sortera och jämföra stavelser för fågelsång med många olika sorters ljud, är något som man länge forskat på inom biologi, för att försöka förstå hur fåglarna lär in sin sång och vad som får den att utvecklas. Metoden för detta är oftast att lyssna och på så sätt avgöra om två ljud är lika eller ej. Detta är givetvis väldigt tidskrävande och lämnar också utrymme för olika tolkningar. Ljuden, stavelserna, är ofta av komplex karaktär och kan variera på många olika sätt. Inom signalbehandling beskrivs sådana ljud som fler-komponent-signaler. Detta projekt handlar om att skapa matematiska metoder som kan särskilja, klassificera, olika typer av sådana signaler. Metoderna är allmänt användbara inom många andra tillämpningar, och ett annat spännande område är hjärnans elektriska aktivitet (EEG). EEG har en mycket fin tidsupplösning, vilket tillåter studium av snabba förlopp. Sådana snabba förlopp förekommer exempelvis då man studerar bilder och skall koppla detta till andra minnesbilder. De elektriska svaren som uppkommer i denna process i hjärnan är också exempel på fler-komponent-signaler.

Tids-frekvensanalys är ett samlingsnamn på matematiska tekniker som skapar en bild av tidpunkt och frekvens för de olika komponenterna. I sin enklaste form benämns det spektrogram eller sonogram. Bilden som genereras från tids-frekvensanalys av en fler-komponent-signal kan liknas vid en karta med hav och öar som ligger utspridda i något mönster. Mönstret anger, relativt axlarna på bilden, tid och frekvens. Öarna, komponenterna, kan ha olika form och också olika höjd (energi). Metoder inom tids-frekvensanalysen syftar till att göra kartan så tydlig som möjlig utifrån den signal man har mätt (fågelsångs-stavelse eller svar från hjärnan).
Målet i detta projekt är att hitta bra beskrivningar av kartan, (features), som kan användas för att dela upp en grupp signaler i olika klasser. Enkla sådana metoder kan vara att ta reda på tid och frekvens för mittpunkten i alla komponenter. 'Reassignment' är en sådan teknik inom tids-frekvensanalys som syftar till att automatiskt stapla allt material (energi) i en komponent till en enda punkt. På så sätt får man en väldigt tydlig karta av exakt var mittpunkten ligger. Utifrån detta kan man sedan på ett lättare och säkrare sätt automatiskt plocka relevanta features.

Svårigheten i projektet ligger i att för olika signaler, som ändå skall tillhöra samma grupp, är inte mönstret, kartan med komponenter exakt lika. Placeringen av olika komponenter kan variera lite grann, liksom storleken och energi på jämförbara komponenter för två olika signaler. Metoderna måste då vara robusta för dessa variationer, d.v.s. ändå generera features som är så lika som möjligt. Samtidigt skall metoderna vara känsliga för de skillnader som finns i signalerna när de tillhör två olika klasser. En bra metod skall uppfylla båda dessa kriterier för att fungera väl i en automatiserad analys av verkliga signaler.

Project period

Number of project years*

4

Calculated project time*

2016-01-01 - 2019-12-31

Classifications

Select a minimum of one and a maximum of three SCB-codes in order of priority.

Select the SCB-code in three levels and then click the lower plus-button to save your selection.

SCB-codes*	2. Teknik > 202. Elektroteknik och elektronik > 20205. Signalbehandling

Enter a minimum of three, and up to five, short keywords that describe your project.

Keyword 1*

Time-Frequency Analysis

Keyword 2*

Feature Extraction

Keyword 3*

Multitaper spectrum

Keyword 4

Keyword 5

Research plan

Ethical considerations

Specify any ethical issues that the project (or equivalent) raises, and describe how they will be addressed in your research. Also indicate the specific considerations that might be relevant to your application.

Reporting of ethical considerations*

The experimental setups and data collections are parts of larger studies where the ethical considerations are approved by the regional ethics committees, in relevant cases.

The project includes handling of personal data

No

The project includes animal experiments

No

Account of experiments on humans

No

Research plan

Tailored Time-Frequency Features for Robust Classification

Purpose and aims

This work is motivated by the increased use of time-frequency tools in many application areas. Often the interest is to cluster or classify specific time series data of non-stationary and multi-component character. Time-frequency analysis is a natural approach for such data. However, many of the methods used today are not optimal from the choice of time-frequency method, nor from the feature extraction view-point. We intend to focus on to tailor the time-frequency spectra using knowledge from experts and to extract features that are optimal for the specific classification and clustering. Especially two exciting and important areas will be considered, where the character of time- and frequency variations are crucial; 1) medical signals - focusing on classification of the electrical signals from the brain in the context of memory retrieval; 2) sound - especially bird song data focusing on syllable clustering of the great reed warbler song. These applications have in common that the variations inside a class might be very large and that the actual differences between classes might be hidden by other large variations. The novel approach in this project is to include knowledge of the expert comments in the design of optimal methods for the time-frequency spectrum calculation as well as for the extraction of features. State-of-the-art methods will be applied for classification and clustering and the results based on different feature sets will be evaluated and compared to existing methods.

Survey of the field

Recently, the use of time-frequency (TF) methods have increased in many application areas, such as speech, vibration analysis, radar, geophysics, and medicine, where signals are often non-stationary and multi-component. In a recent overview paper in automatic speech recognition, [1], it is concluded that existing methods might have relied too much on language models to overcome the coarse acoustic modeling using Hidden Markov Models (HMM) and Mel-Frequency Cepstral Coefficients, (MFCC) and that it would make more sense to utilize TF patterns. The interest has also more and more shifted from applications where linearly frequency modulated signals are estimated to more applications with multi-component signals, often related to biological and biomedical signals such as the electroencephalogram (EEG), heart rate variability (HRV) and others, [2].

Studying a TF image, e.g. a spectrogram, often give excellent information and visual analysis based on this view has the potential to be very efficient, as an expert knows what to look for and which parts to ignore. For many applications, there are also already modern TF based tools that works satisfactorily. However, in other areas, the application of these tools will not give the desirable result. In this project we will focus

on a special type of signal model, for which we can find, at least two interesting application areas for classification, and where most existing methods will fail. The signal model is multi-component, meaning that several components (atoms) are detectable in the TF image. The realizations which should belong to the same class are allowed to have a component-wise stochastic variation, in time, frequency as well as amplitude. Such stochastic variations are not often seen in existing models. Most models are deterministic and the focus is on reducing disturbing noise. In our applications, disturbing noise is a large problem which calls for robust methods. However, the main goal is to handle the stochastic variation of the individual components. Additionally, signals in different classes might share TF overlapping components of strong power. The important between-class differences are then located to certain differences in time, frequency or amplitude of possibly weaker components which calls for sensitive and tailored methods.

The Time-Frequency Spectrum

The general quadratic class of TF representation methods can be used for our purpose where kernels for optimal classification of non-stationary processes can be designed in various ways. The term time-frequency spectrum has been established nowadays and the ambiguity function is replaced by the somewhat more unknown *ambiguity spectrum* (AS), $A_x(\nu,\tau) = \int E[x(u+\frac{\tau}{2})x^H(u-\frac{\tau}{2})]e^{-i2\pi\nu u}du$ where $E[*]$ denotes expected value, $x(t)$ is the measured process realization and H is the conjugate transpose. The fundamental problem is the estimation of a TFS from a single realization or a set realizations of the process, computed as

$$\hat{W}_x(t,f) = \int\int \hat{A}_x(\nu,\tau)\phi(\nu,\tau)e^{-i2\pi(\tau f - t\nu)}d\tau d\nu, \tag{1}$$

where $\phi(\nu,\tau)$ is an ambiguity *kernel*, and $\hat{A}_x(\nu,\tau)$ the estimated AS. An extensive literature of optimal ambiguity kernels can be found, [3]. Most of these kernels are actually optimal for estimation or detection of a deterministic signal in noise and for suppression of cross-terms but in many applications these work very well. However, for non-stationary processes, an extensive framework for what is called underspread processes has been developed, [4]. A special case of this is the *locally stationary process*, [C17], for which a mean square error (MSE) optimal kernel can be estimated and the corresponding parameters can be found using *multitapers* (MT), [C8]. We have also derived the optimal MSE kernel for a multi-component process, [C29]. (The references [C number] are found in the publication list of the main applicant).

Multitapers

A multitaper TF spectrum is expressed as a weighted sum of spectrograms, using the weights λ_k and the tapers $q_k(t)$,

$$W_x(t,f) = \sum_{k=1}^{\infty}\lambda_k S_k(t,f) = \sum_{k=1}^{\infty}\lambda_k E[|\int x(t_1)q_k^H(t-t_1)e^{-i2\pi f t_1}dt_1|^2]. \tag{2}$$

Originally, MTs were introduced by David Thomson, see [5] and references therein, where the discrete Prolate Spheroidal Sequences, are used to estimate a low-variance spectrum of a pre-specified resolution. The Thomson MT are well established in stationary spectrum analysis today and have been used to estimate robust spectra in many applications areas. The minimum bias MTs, (sinusoidal tapers), [5], and the Peak Matched Multiple Windows (PM MW), [C19],[5] are not that well known but might be more suitable for certain applications, especially for spectra with large dynamics. The PM MW are used in applications such as heart rate variability data, [C1,C14,C15] and speaker recognition, [C4,C12], [6]. In recent years, the *Hermite functions* are more and more used in applications where the interest is to estimate the TF spectrum of non-stationary signals, e.g., [C5,C6,C8], [7, 8]. The main advantage is that these functions are the most optimal, considering the aspect of TF localization and general orthonormality in the TF domain. MT spectrograms can be designed using properties related to data, giving both low variance and low bias of the estimate, [C7,C9].

Time-frequency localization

Many of the recent papers focus on improvement of parameter values of existing TF methods to increase localization of components in the spectrum and to suppress cross-terms, e.g. [2]. However, two new popular techniques are the synchrosqueezing transform, which allows for reconstruction, and the reassignment method, which achieves a compact TF representation, [9]. In, [10], an synchrosqueezed TF transform is proposed to characterize the TF pattern of multi-component non-stationary signals. The method is independent of the signal amplitude, thus it can be used also for weak signal detection. Reassignment is applied to increase the concentration of a single TF component by relocating mass to the center of gravity. It has been shown to give perfect localization of the instantaneous frequency for impulses, sinusoids and chirp signals.

Instantaneous frequency (IF) estimation has for a long time been focused on parametrization of one single linear or non-linear chirp signal. Recent work has expanded to also identifying multi-component chirp signals in various ways, e.g. using de-chirping, [11]. There has also been a large interest in using sparse coding, e.g. [12], where the sparsity of the ambiguity kernel is used for an optimal estimation of the auto-components of a multi-component signal. The reassignment and de-chirping methods seem to render good estimates, although they typically require rather large data sets to do so. In [C26], we present a method for estimating the parameters detailing an unknown number of multi-component linear chirp signals, using an iterative sparse reconstruction framework. One of the advantages is that it also approximates multi-component non-linear chirps by a piecewise linear model and that the method only requires a small amount of data samples for an accurate estimate. The refinement of this technique is an ongoing project. The recently proposed Levenberg-Marquardt reassignment, is an adjustable method where the user can choose if a weak or strong localization should be made and also adapt to short transients or stationary tones, see references in [9]. We have proposed a more simplified method to localize short

pulses, called *scaled reassignment*, which is based on the spectrogram using a Gaussian window, [C2,C23,C27]. The resulting reassignment gives perfect localization (a single point) for a Gaussian atom, i.e. a sinusoidal Gaussian windowed component, and the scaling can be estimated to fit different lengths of atoms.

Feature extraction

Using the TF image for feature extraction has been in focus of many applications areas, e.g. [1, 2, 13, 14, 15, 16]. However, the choice of the features have usually been generic, such as the mean, variance and higher moments of the time- or frequency profile (marginal). One important focus has been the noise reduction in the TF spectrum, using image processing techniques combined with wavelets and singular value decomposition (SVD), [2]. Also related to image analysis is the so called TF masking, [17], which is a more clever way of choosing relevant information than just using the averaged power in a grid of the TF spectrum, [14, 15]. Parametric methods, identifying the differences of certain components, can also be found, e.g. [11], [C2]. Parametric methods as well as the reassignment technique will usually be quite sensitive to disturbances as well as small variations of the signals to be classified. In [18, 19], the discretized TF image is decomposed into a set of basis matrices with the singular vectors representing the TF marginal of each basis matrix. The marginals are used to calculate the temporal and spectral moments which are a subset of all joint TF moments building the AS in a Taylor series expansion.

Applications of the project

Memory retrievals: The area of functional magnetic resonance imaging (fMRI) of the brain, has received a lot of attention lately, and advanced methods for the statistical classification have been developed. Multi-voxel pattern analysis (MVPA) is one of the most applied, which uses machine learning techniques to classify distributed patterns of brain activity. This method has already been widely applied to fMRI data to discriminate retrieval of different conceptual categories and to reveal brain regions, supporting episodic memory consolidation and retrieval. In fMRI analysis, time-resolution is very low, and short-time dependent responses cannot be detected. Therefore, there is an increased interest to use multi-channel electrical signals (measured as EEG or MEG), which are known to have the required time-resolution, although the spatial resolution is worse than in fMRI and the noise level is high. It is therefore important to extract relevant and robust features to capture the time- and frequency variations. Few papers are found in this area at all and the features chosen are basic ones, such as totally time-based, smoothed over a time interval, [14] or average power in specific frequency bands, [15]. Such features might work for certain data but will fail for responses related to memory retrievals, where the activity is not necessarily time-locked and strong power components are overlapping between classes. An interesting idea is of course to combine the information from the fMRI and EEG experiments, [20], (Pub. 24 of co-applicant M. Johansson).

Syllable clustering: In biology, bird song analysis has been a large field for over 40 years and since many years it has been realized that information from the spectrogram (sonogram), is the best tool when comparing different sounds. Songs recorded from wild birds under natural conditions where distorsion, such as wind and sound interference from other birds, make analyses challenging. To classify the sound of *different bird species*, where usually the patterns are quite different, features such as time- and frequency mean, variance and higher moments as well as time duration and frequency bandwidth are often used. The speech analysis method of MFCC has also been applied, and other features found from speech analysis are pitch frequency, dynamic time warping (DTW), see [21] and references therein. Pairwise cross-correlation of spectrogram (SPCC) has recently been investigated and compared to other standard features, [16]. The conclusion was that the SPCC method is the best in analysis of bird song. The classification of bird species is difficult in the sense that usually the song is automatically cut into time intervals of pre-defined lengths, and comparing data of one time epoch to another must be made with care. The SPCC is able to deal with some of these problems as a pairwise correlation of images ignore time- and frequency shifts of the total signal. However, it is notable that the variations between species are usually quite large and the problem of classification becomes much easier to solve in that sense. For one species with a complex song such as the great reed warbler, the analysis has so far been made by hand, listening and visually studying the *syllable* sonograms and extracting parameters for further analysis, [22] (Pub. 1 of co-applicant D. Hasselquist) and [23]. Most of the methods and features related to classification of different bird species will fail in the analysis of the great reed warbler as they usually smooth out the differences that should be detected.

Project description

The proposed project intend to develop and investigate new robust features extracted for classification of non-stationary multi-component signals. Below a number of ideas are suggested. They are not ordered according to any fixed timeline but from the level of difficulty, number 4 and 5 are suggested as part-projects for the Post Doc position, number 1, 2 and 3 are suggested as part-projects for the PhD (possibly also in this order) and finally 6 could be investigated as a Master thesis project or as a PhD part-project. Simulated data as well as small real data sets for evaluation will be used in all part-projects. Promising novel features will also be implemented and evaluated for larger data sets, connected to each of the applications. Responsible for these evaluations will be Maria Sandsten together with Dennis Hasselquist and Mikael Johansson.

1. The approach in [24], where the in-class variances are minimized and the between-class variances are maximized, for an arbitrary ambiguity kernel is promising. However, using a priori information of data, e.g. a model of locally stationary processes, and further use the optimal ambiguity kernel for this process, optimizing the parameters, would certainly give a better result for a given application. We have also shown in an earlier work, that using one model that is fitted to a

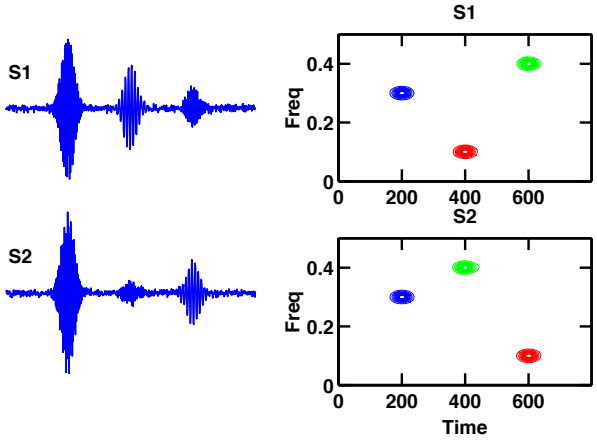

Figure 1: Two examples of simulated multi-component signals disturbed by a small amount of noise, where S1 and S2 belong to different classes. The left and right singular vector pair outer products of the spectrogram image is colored as $\mathbf{u}_1 \cdot \mathbf{v}_1^H$-blue, $\mathbf{u}_2 \cdot \mathbf{v}_2^H$-red, $\mathbf{u}_3 \cdot \mathbf{v}_3^H$-green

family of processes is almost as optimal as using the individual model for each process, [C6]. One family-optimal ambiguity kernel can then be applied for all classes.

2. The technique from [18, 19], can be further explored and is interesting for several reasons. The singular vectors (SV) preserves the important property of orthogonality for a feature set in classification and offers a way of sorting out important time- and frequency differences between classes. Especially when large power components are the same between classes, see example in Figure 1, where the outer product of the SV, $\mathbf{u}_r \cdot \mathbf{v}_r^H$ for $r = 1$ (blue) are similar between classes and the differences is found for $r = 2, 3$ (red and green). For such signals, most usual techniques, e.g. the time- and frequency profiles will fail as these profiles will be more or less the same for S1 and S2, focusing on the amplitude differences instead of the time- and frequency structure of the image. As the power of the component will be localized to the singular values, using the SV are of special interest for feature extraction of signals with stochastic amplitudes. The SV also offers a great advantage for noise reduction as the noise will be captured in orthogonal singular vectors. However, we could note and leave for investigation, that for a signal with components at the same frequency or time instant, the SVs do not capture the component information as clean as in Figure 1.

3. We also aim at investigating the AS instead of the TF spectrum. To use the AS for feature extraction has several advantages. Compared to the TF spectrum, the ASs of two time- and frequency-shifted signals are identically the same, meaning that a small jitter in time- and frequency (e.g. a small tone shift in a bird song), will not affect the result. This is also handled by the correlations of TF spectra, (SPCC). However, an important problem that the SPCC method cannot deal very well with, is when multi-component signals have stochastic

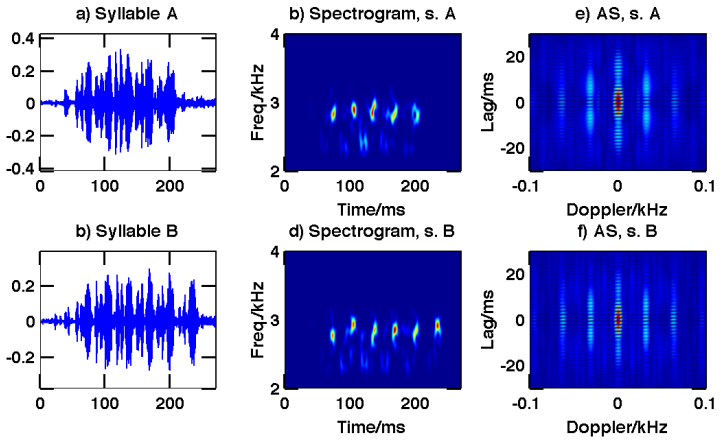

Figure 2: Two bird song syllables that belong to the same class, with corresponding spectrograms and ambiguity spectra.

jitters in all components as well as in the number of components, see example in Figure 2, of two recorded bird song syllables which belong to the same class. These two syllables have different number of components, with jitter in time, frequency and amplitudes. The AS has the nice property of focussing on time- and frequency differences (lag and doppler), and therefore the two ASs have more similar properties than the corresponding TF spectra. This will also be an advantage in the case when two signals, belonging to the same class, have different number of harmonics.

4. The MT formulation of a TF spectrum, Eq. (2), is advantages as feature extraction actually can be made from the individual spectrograms, $S_k(t, f)$, and could be combined for further analysis. As the different spectrograms are uncorrelated (for an optimal choice of windows), the features from individual spectrograms can be expected to have properties that are valuable to explore further. This is an approach that we have not seen in literature at all and it would be interesting to investigate the features from different $S_k(t, f)$ and explore how they should be combined for an optimal result. For the optimal ambiguity kernels from part-project 1, the corresponding MT spectrum could be derived and used for further analysis.

5. Using the scaled reassignment, [C2], the resulting reassignment gives perfect localization for a transient Gaussian function. In a pre-study, we have also shown that non-linear combinations of scaled reassigned spectra can be valuable, [C23]. This can, however, certainly be made more optimal and a suggested approach would be to use the combination of the reassigned Gaussian windowed spectrograms of several Hermite functions (not just the first one, i.e. the Gaussian window). The theoretical foundation for this was recently presented in [25], and can be further explored.

6. The MFCC is a well known method for speech analysis. In the area of speaker

recognition, we have an ongoing collaboration with Dr. Tomi Kinnunen, SIPU, University of Eastern Finland, Joensuu, where we have considered the optimal MT MFCC for classification, see e.g., [C4,C12] and [6]. For syllable classification, the MFCC are not necessarily the best but a natural approach would be to further combine MT and cepstral analysis, [C3,C5], possibly suggesting a more (bird song) optimal frequency-scale than the perceptual optimal well known mel-scale.

Applications and data resources

Memory retrievals: For the memory retrieval data, the experiments, data collections and final MVPA for the classification are made at department of Psychology, Lund University, by Professor Mikael Johansson and collaborators, as a part of another project where needed resources already are available. The classification will include novel features from this project, where the classifiers will be trained to discriminate between the EEG oscillatory brain activity recorded when pictures belonging to different categories (e.g. face, place, object) are presented during the encoding phase of the proposed studies. Then the MVPA of high time-resolution EEG data allows us to characterize changes in memory reactivations (timing, strength, content) during the act of a retrieval attempt, as well as across multiple retrieval attempts.

Syllable clustering: For the bird song analysis, the data resources are recorded at the great reed warbler population at Lake Kvismaren, where the population has been monitored in detail at an individual level throughout the breeding season each year since 1983. The song of each male has been recorded every season by Professor Dennis Hasselquist and collaborators, department of Biology, Lund University. Our aim is to detect and cluster the syllables of the individuals of the great reed warbler, and to compare how the syllable vocabulary matches between birds and changes between years. As the number of classes of a song is unknown and as the relevant detail level of the clustering also, to some extent, is unknown, we prefer to use un-supervised clustering algorithms for this project. The choice of an appropriate method depends on the data under study and the goal of the analysis, but we suggest hierarchical clustering as this method does not require as input a pre-specified number of clusters. A pre-study and initial attempt of this collaboration is presented in [C32].

Significance

The proposed project intend to develop new tools in time-frequency image feature extraction for classification and clustering. Especially, the focus will be on non-stationary multi-component signals. We believe that the novel methods will have impact in the two areas considered in the application, classification of the electrical signals from the brain related to memory retrievals and clustering of bird song syllables. In both these areas, the lack of robust tools severely hampers the research. However, the approaches in this project are of general character and may have an impact in other application areas as well, such as e.g. speech analysis, where there is also a large interest to find new and more sensitive classification tools.

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Interdisciplinarity

My application is interdisciplinary

☐

An interdisciplinary research project is defined in this call for proposals as a project that can not be completed without knowledge, methods, terminology, data and researchers from more than one of the Swedish Research Councils subject areas; Medicine and health, Natural and engineering sciences, Humanities and social sciences and Educational sciences. If your research project is interdisciplinary according to this definition, you indicate and explain this here.

Click here for more information

Scientific report

Scientific report/Account for scientific activities of previous project

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Budget and research resources

Project staff

Describe the staff that will be working in the project and the salary that is applied for in the project budget. Enter the full amount, not in thousands SEK.

Participating researchers that accept an invitation to participate in the application will be displayed automatically under Dedicated time for this project. Note that it will take a few minutes before the information is updated, and that it might be necessary for the project leader to close and reopen the form.

Dedicated time for this project

	Role in the project	Name	Percent of full time
1	Applicant	Maria Sandsten	20
2	Participating researcher	Mikael Johansson	5
3	Participating researcher	Dennis Hasselquist	5

Salaries including social fees

	Role in the project	Name	Percent of salary	2016	2017	2018	2019	Total
1	Applicant	Maria Sandsten	20	223,000	230,000	237,000	244,000	934,000
2	Other personnel without doctoral degree	Doktorand	80	360,000	370,000	382,000	393,000	1,505,000
3	Other personnel with doctoral degree	Post Doc	100			630,000	650,000	1,280,000
4	Participating researcher	Mikael Johansson	5	52,000			57,000	109,000
5	Participating researcher	Dennis Hasselquist	5	51,000			56,000	107,000
	Total			686,000	600,000	1,249,000	1,400,000	3,935,000

Other costs

Describe the other project costs for which you apply from the Swedish Research Council. Enter the full amount, not in thousands SEK.

Premises

	Type of premises	2016	2017	2018	2019	Total
1	Arbetsrum	40,000	35,000	74,000	81,000	230,000
	Total	40,000	35,000	74,000	81,000	230,000

Running Costs

	Running Cost	Description	2016	2017	2018	2019	Total
1	Resor	2 Konf. 2-3 pers.		26,000	40,000	40,000	106,000
2	Datorer	2 Datorer	20,000		20,000		40,000
	Total		20,000	26,000	60,000	40,000	146,000

Depreciation costs

Depreciation cost	Description	2016	2017	2018	2019

Total project cost

Below you can see a summary of the costs in your budget, which are the costs that you apply for from the Swedish Research Council. Indirect costs are entered separately into the table.

Under Other costs you can enter which costs, aside from the ones you apply for from the Swedish Research Council, that the project includes. Add the full amounts, not in thousands of SEK.

The subtotal plus indirect costs are the total per year that you apply for.

Total budget

Specified costs	2016	2017	2018	2019	Total, applied	Other costs	Total cost
Salaries including social fees	686,000	600,000	1,249,000	1,400,000	3,935,000		3,935,000
Running costs	20,000	26,000	60,000	40,000	146,000		146,000
Depreciation costs					0		0
Premises	40,000	35,000	74,000	81,000	230,000		230,000
Subtotal	746,000	661,000	1,383,000	1,521,000	4,311,000	0	4,311,000
Indirect costs	322,000	286,000	597,000	657,000	1,862,000		1,862,000
Total project cost	1,068,000	947,000	1,980,000	2,178,000	6,173,000	0	6,173,000

Explanation of the proposed budget

Briefly justify each proposed cost in the stated budget.

Explanation of the proposed budget*

The project leader Maria Sandsten will work 20% of full time in the project for the years 2016-2019. One PhD students will work 80% of full time in the project for all four years and a Post Doc will work 100% the years 2018-2019. Maria Sandsten will have the main responsibility for the guidance of the PhD student as well as the Post Doc. For the collaborators Mikael Johansson and Dennis Hasselquist, a cost of 5% is added for two specific years (2016, 2019). Initially, they will be involved in extracting relevant data and sharing knowledge of class differences. At the end of the project they will assist in the evaluation of new features, which to a larger extent also is a part of their own research and is not financed by this project. The budget per year includes the salaries according to the above description and additional 50% LKP and 45.64% overhead. Additional costs for office rooms are incldued. The budget also accounts for three conference travels for 2-3 persons, (2017, 2018 and 2019) and a computer for the student (2016) and one for the Post Doc (2018).

Other funding

Describe your other project funding for the project period (applied for or granted) aside from that which you apply for from the Swedish Research Council. Write the whole sum, not thousands of SEK.

Other funding for this project

Funder	Applicant/project leader	Type of grant	Reg no or equiv.	2016	2017	2018	2019

CV

CURRICULUM VITÆ - Maria Sandsten (Hansson)

Born: 7/11 1966, Lingbo, Sweden. Status: Married, two children (born 1997 and 2001), Swedish citizen. Affiliation: Centre for Mathematical Sciences, Mathematical Statistics, Lund University, Box 118, 221 00 Lund, Sweden. Telephone: +46 46222 49 53. E-mail: sandsten@maths.lth.se. Homepage: www.maths.lth.se/matstat/staff/mh.

1. Master of Science in Electrical Engineering, Lund University, 1989.

2. Ph.D. in Signal Processing, Lund University, 1996, entitled "On Signal Dependent Basis Functions, Estimation of Event Related Potentials and Multiple Window Spectrum Analysis", supervisor: Professor Göran Salomonsson.

3. Postdoctoral Fellow at the department of Applied Electronics, Lund University, 1997-2003.

4. Docent in Signal Processing, 2004.

5. Professor in Mathematical Statistics with speciality in Statistical Signal Processing, at centre for Mathematical Sciences, Lund University, 2010-. Amount of research: 40%, teaching: 30%, administration 30%.

6. Assistant and associate professor at Centre for Mathematical Sciences, 2003-2004, 2004-2010.

7. Head of division at Mathematical Statistics, 2008-2012, 25-40%. Parental leave, 25-100%, for two children during various periods 1997-2002 and 10-20%, 2003-2009. Total time of parental leave, approximately 3-4 years.

8. Supervision:

   Main supervisor of PhD student Johan Brynolfsson, 2012-. (100%).

   Main supervisor of PhD student Johan Sandberg, 2005-2010, (exam 2010) (100%).

   Acting main supervisor of PhD student Joakim Axmon, 1998-2004, (exam 2004). (100%).

   Supervisor of PostDoc Dr. Taigang He, 1999-2000, (100%).

   Assistant supervisor: PhD student Johan Swärd, 2012-. (20%). Assistant supervisor of PhD Behnaz Pirzaminbin, 2011-. (< 10%). Assistant supervisor of PhD student Gerd Waldhauser, 2009-2011, (exam 2011). (< 10%). Assistant supervisor of PhD student Stefan Ingi Adalbjörnsson, 2009-2014, (exam 2014). (< 10%). Assistant supervisor of PhD student Naveed Butt, 2008-2011, (exam 2011). (< 10%).

9. - **Academic leadership**: Member of the board of recruitments, LTH, 2013-2015 (15%). Vice coordinator for Engineering in Mathematics, LTH, 2013-2015, (15%). Member of the board of the strategic research area E-science at LTH, 2013-2016. Member of the board of Lunarc, 2012-2014. Member of the board of research, FN1, 2009-2011. Head of division Mathematical Statistics, 2008-2012

$(25-40\%)$Member of the board of CIEL, 2008. Member of the referee group of the The Humanities Laboratory, 2008-2009. Vice coordinator for Engineering in Mathematics, LTH, 2006-2008 (15%). Member of the board of the Centre for Mathematical Sciences, Lund University, 2006-2008, (supp. 2006-2007). Member of the Educational committee in European Consortium for Mathematics in Industry (ECMI), 2006-2008. Member of the advisory board at Mathematical Statistics, Lund University, 2005-2007. Suppleant of the recruitment committee, FIME, LTH, 2003-2005. Member of the representative faculty staff, LTH, 2002-2005.

- **Larger grants**: Strategic research for E-science-Essence, 'Classification tool for bird singing', 1440 kkr, 2012-2014. VR-621-2011-5813, 2400 kkr, 2012-2014, VR-621-2007-6264, 750 kkr, 2008. VR-621-2004-4692, 1860 kkr, 2005-2007. Researcher in technical science, 'särskild forskare', VR-622-2003-602, 5700 kkr, 2004-2009 (prolonged until -2013). VR-621-2001-3120, 1200 kkr, 2002-2003, (co-applicant). VR-621-2001-3119, 1000 kkr, 2002-2003. TFR-271-2000-605, 490 kkr, 2001. TFR-271-1997-627, 1400 kkr, 1998-2000.
- **Publications** of more than 25 international journal papers and over 35 conference papers. Co-author of 6 patents in the area of telecommunication, different algorithms for measurement of parameters in a telecommunication system and one patent (in several countries) for determining and monitoring the degree of narcosis in humans.
- **Review tasks**: Associate editor for IEEE Trans. on Signal Processing, 2008-2010. Regular referee for: IEEE Trans. on Signal Processing, Elsevier Signal Processing, IEEE Trans. on Biomedical Engineering, IEEE Trans. on Speech and Audio Processing, Elsevier Medical Engineering and Physics.
- **Opponent**: Tromsö University, Heidi Hindberg, "Time-Frequency Characterization of Harmonizable Random Processes", 2009, (second opponent). Licentiate opponent at Lund University, Frida Nilsson, "Time-Frequency Analysis of Atrial Fibrillation", 2007. Faculty opponent at Royal Institute of Technology, Håkan Carlqvist, "Multiscale analysis of Multi-channel signals", 2005. Licentiate opponent at Blekinge Institute of Technology, To Tran, "Sequential Complex FIR-structure Optimization", 2005.
- **Member of Ph. D. examination committee** at more than 20 occasions.
- **Supervisor** of more than 30 master thesis projects
- **Cooperation with industry**: Oticon Medical, master thesis projects on cochlear implant technology, 2015-. Medetect AB, master thesis projects on cross-correlation of cell images, 2014-. Sensodetect AB, master thesis projects on estimation of auditory brain stem responses, 2012-. Skogforsk, Project on detection of root rot, 1998-2004. Telia, Project on non-intrusive measurements of telephone channels, 1992-1995. Biolin Medicals AB, Project on measurement of depth of anesthesia, 1991-1993.

CV for Dennis Hasselquist (*Web site: http://www.biology.lu.se/dennis-hasselquist*)

1. Higher education degree (university exam)
Fil. lic. in Biology at Lund University in spring 1988.

2. Doctoral degree
Doctor of Philosophy in Animal Ecology (Oct 1994). Thesis entitled "Male attractiveness, mating tactics and realized fitness in the polygynous great reed warbler", Lund University.

3. Post doctoral positions
At Cornell University, NY, USA (supervisor: Paul W. Sherman), 1995.08.01 – 1996.07.31 (paid by SJFR, extra grants from Fulbright Commission and Swedish Institute).

4. Docent level
I was assigned the title "Docent" (Associate Professor) at Lund University in May 1999.

5. Present position
Appointed as full Professor at Dept of Animal Ecology, Lund University from 2007.04.18 (80% research/administration, 20% teaching). Since 2012, I am Examiner for 5 PhD-students in Ecology at Dept of Biology, LU (responsible for thesis check and defense)..

6. Previous academic positions
1. Postgraduate fellowship, 100% – 901101-941030, Dept of Animal Ecology, Lund Univ.
2. Research ingenieur (repatrieringsbidrag, SJFR), 100% – 960801-961231.
3. Assistant professor (forskarassistent, SJFR), 100% – 970101-040228.
4. Visiting researcher (20-50%) at Max Planck Institute for Limnology, Dept Evolutionary Ecology, Plön, Germany (host: Manfred Milinski). – 010615-020731.
5. Researcher (forskare; paid by Formas 50% and Dept Animal Ecology Lund 50%), - 040301-061231, Dept Ecology, Lund Univ. Time for research 75%.
6. Researcher (forskare; paid by Formas 50%, VR 25% and Dept Animal Ecology Lund 25%), – 070101-070417, Dept Ecology, Lund Univ. Time for research 75%.

7. Interruption in reseach - parental leave (föräldraledighet)
1. Parental leave with Emilia (50-100%) for a total of 3.5 months – 970220-980228.
2. Parental leave with Emilia and Max (20-100%) for a total of 8.5 months – 010601-030515.

8a. Supervision of PhD students
1. Lars Råberg (Principal supervisor: D Hasselquist). Defended thesis 2002. Present position: Asoc Prof, LU.
2. Bengt Hansson (Princ supervisor: S Bensch). Def thesis 2003. Pres position:Asoc Prof LU.
3. Martin Stjernman (Princ superv:JÅ Nilsson).Def thesis 2004. Pres position:Researcher LU.
4. Jonas Waldenström(Principal supervisor:D Hasselquist,B Olsen).Defended thesis Dec 2005. Present position: Asoc Prof, Linnaeus Univ, Kalmar.
5. Mikael Åkesson (Principal supervisors: D Hasselquist, S Bensch). Defend thesis Sep 2006. Present position: Ass Prof, SLU Grimsö.
6. Olof Hellgren (Princ supervisor:S Bensch). Def thesis 2006. Present position:Ass Prof LU.
7. Balazs Rosivall, E Lorand Univ, Hungary (Ext superv. D Hasselquist). Defend thesis 2007. Present position: Lecturer, E Lorand Univ, Budapest, Hungary.
8. Eszter Söllözi, E Lorand Univ, Hungary (Ext superv. D Hasselquist). Defend thesis 2008.
9. Sara Naurin (Principal supervisors: D Hasselquist, S Bensch). Def. thesis 2009. Science Application Advisor.
10. Sanna Nilsson (Principal supervisor: L. Pettersson). Defended thesis 2010. Environmental Advisor.
11. Maja Tarka (Principal supervisor: D Hasselquist, B Hansson). Def. thesis 2012. Pres pos: Post doc.
12. Asghar Muhammad (Principal supervisor: S Bensch). Def. thesis 2012. Pres.pos: Post doc.
13. Sandra Chiriac (Princ. supervisor: D Hasselquist, JÅ Nilsson). Scheduled defence 2015.

14. Luis Gordinho, CIBIO Porto, Portugal (Princ supervisor: D Hasselquist). Defence 2015.
15. Jacob Roved (Princ. supervisor: H. Westerdahl, D. Hasselquist). Scheduled defence 2017.

8b. Supervision of post doctoral fellows

1. Supervising Dr. Sveinn Are Hanssen, Tromsö Univ, Norway, for his post-doctoral Fellowship carried out at Lund University (2003-2005). Present position: Researcher, NINA and U Tromsö, Norway.
2. Supervising Dr. Julio Neto, for his post-doctoral Fellowship carried out at Lund Univ and CIBIO Porto Univ (2005-2013).
3. Supervisor (shared) for Dr. Barbara Tschirren, Bern Univ for her post-doc from the Swiss Research Council (2009-2010). Pres pos: Asoc Prof, Univ Zürich, Switzerland.
4. Supervisor (shared) for Irene Pala during her 1.5 year post doc funded by Swedish Institute and LU (2010-2011).
5. Supervisor (and returning host) for Michael Tobler, Bern Univ, Switzerland, for his 3 year Outgoing Marie Curie post doctoral fellowship (2010-2014).
6. Supervisor for Goetz Eichhorn, Univ Strasbourg, for his 2 year Marie Curie EU post doctoral fellowship (2012-2014).
7. Supervisor (shared) for BriAnne Addison, for her CAnMove post doctoral Fellowship at Lund Univ (2011-2012). Present position: Lecturer, Univ Western Sydney, Australia.
8. Supervisor (shared) for Emily O'Connor, for her CAnMove post doctoral Fellowship at Lund Univ (2012-2014).
9. Supervisor (shared) for Arne Hegemann, for his Rubicon (the Netherlands Research Council) post doctoral Fellowship at Lund Univ (2014-2016).

9. Awards, "Among 20 most influential animal behaviour researchers…." etc

1. I was awarded a J. William Fulbright Foreign Scholarship for my post doctoral project at Cornell University, NY, USA. – July 1995.
2. I was qualified for a Professorship, and ranked as top candidate in Ethology at Univ Trondheim, Norway. (Withdraw application for family reasons.) – Jan. 2003.
3. I am a PI of the group "Centre of Animal Movements" at Lund Univ that was funded by VR with a "Linnaeus - Excellent Research Environment" grant in 2008 (10 year grant 5 000 MSEK/year for 10 years).
4. I was on the list of the 20 most influential researchers in animal behaviour in Europe 2012 (I was ranked 12; the highest rank of the two Swedes on the list). The list (based on citations) was compiled by *Lab Times* – a news magazine for the European Life Sciences (http://www.labtimes.org/labtimes/ranking/2012_03/index.lasso).

11. Opponent on PhD thesis, Examination committee member, Evaluator

1. I have been opponent on two PhD theses; (1) " Infidelity in birds" by Jakob Augustin, Gothenburg Univ; Sweden, 4 May 2012, (2) "Skylark ecology and physiology over annual-cycle" by Arne Hegemann, Univ Groningen, the Netherlands, 23 Nov 2012.
2. External examiner on two doctoral theses: (i) Anne Peters, Dept Biology, Australian Natl Univ, Canberra, Australia (2001), (ii) Rosa Maria de Ayala, Univ Madrid, Spain (2008).
3. Examination committee member for six doctoral theses: Roger Härdling, Dept TheorEcol, LU (2000), Germund von Wowern, Dept ChemEcol, LU (2006), Hanne Løvlie, Dept Zoology, Stockholm Univ (2007), Per Henningsson, Dept TheorEcol, LU (2010), Eman Soubani, Dept Biol, LU (2010), Zuguang Guan, Dept Physics, LU (2010).
4. External evaluator of an application for a full Professorship at Uppsala University (applicant: Ingrid Ahnesjö), autumn 2010, and of a lecture/professorship in Biology at Södertörns Högskola, spring 2011 (15 applicants).

12. Teaching activities

In total 1988-2013, I have conducted ***in total 7846 clock hours*** of teaching on ecology and evolution courses (incl. main organizing teacher 15 times on advanced 10 weeks courses).

Curriculum Vitae - Mikael Johansson
Department of Psychology, Lund University
Box 213, SE-22100 Lund, Sweden
Telephone: +46-(0)46-2223639
Fax: +46-(0)46-2224209
Email: mikael.johansson@psy.lu.se
Web: www.psy.lu.se/Mikael-Johansson

1. Higher education qualification
1995, Bachelor degree in Philosophy and Psychology, Lund University

2. Doctoral degree
2002, Psychology, Lund University. Title: *Memory illusions and memory attributions: Behavioural and electrophysiological data.* Supervisor: Prof. Georg Stenberg

3. Postdoctoral position
2002-2004 Experimental Neuropsychology Unit, Department of Psychology, Saarland University, Germany

4. Qualification required for appointments as a docent
2009

5. Current position
Professor, 2010–present, 50% research

6. Previous positions and periods of appointment
- Research Assistant (amanuens). Department of Clinical Neuroscience, Division of Clinical Neurophysiology, Lund University Hospital (1997–1998)
- Predoctoral Research Fellow (doktorandtjänst). Department of Psychology, Lund University (1998–2002)
- Postdoctoral Research Fellow. Experimental Neuropsychology Unit, Department of Psychology, Saarland University, Germany (2002–2004)
- Assistant Professor. Department of Psychology, Lund University (2004–2008)
- Associate Professor. Department of Psychology, Lund University (2009–2010)

7. Interruption in research
- Parental leave (09/2005–10/2005)
- Parental leave (02/2008–08/2008)
- Parental leave (09/2011–01/2012)

8. Supervision
Gerd Waldhauser, PhD graduate (2006–2011); Susanna Bernstrup, PhD graduate (2009–); Robin Hellerstedt, PhD graduate (2010–); Emelie Stiernströmer, PhD graduate (2011–); Inês Bramão, Postdoc (2014–); Richard Dewhurst, Postdoc (2014–); Roger Johansson, Postdoc (2014–)

9. Additional information
Scholarly/academic societies (only appointed/elected member)

- Secretary of the Swedish National Committee for Psychological Sciences, appointed by the Royal Swedish Academy of Sciences (KVA)
- Board member at the Department of Psychology, Lund University

Distinctions

- Doctoral Dissertation Award, Oscar II Foundation (2004)
- Award to Young Scientist in Psychology, Royal Swedish Academy of Sciences / Swedish National Committee for Psychological Sciences (2004)

Ad hoc manuscript refereeing
Annals of the New York Academy of Sciences / Brain & Cognition / Brain Research / Cognition & Emotion / Cognitive, Affective, and Behavioral Neuroscience / Cognitive Brain Research / European Journal of Cognitive Psychology / Journal of Cognitive Neuroscience / Journal of Neuroscience / Memory & Cognition / NeuroImage / Neuropsychologia / Neuropsychology / Neuroscience / Neuroscience and Biobehavioral Reviews / PLOS ONE / Psychiatry Research / Psychological Science / Psychophysiology / Scandinavian Journal of Psychology / Vision Research

Ad hoc grant refereeing
Member of the evaluation panel in psychology, Swedish Research Council (Vetenskapsrådet) 2011–2013
Postdoctoral grants and Grants for Distinguished Young Researchers, Swedish Research Council (Vetenskapsrådet)
Fund for Scientific Research-FNRS, Brussels, Belgium
Wellcome Trust, United Kingdom

Publications
36 peer-reviewed articles, 1 book chapter, 1 doctoral thesis, 64 conference contributions, 3 technical reports

Publication list

PUBLICATIONS- Maria (Hansson-)Sandsten

1. Journal papers (Google Scholar: all citations larger than five included)

1. K. M. Gates and L. M. Gatzke-Kopp and M. Sandsten and A. Y. Blandon, "Estimating time-varying RSA to examine psychophysiological linkage of marital dyads", accepted for publication.

2. *M. Hansson-Sandsten and J. Brynolfsson, "The scaled Reassigned Spectrogram with perfect localization for estimation of Gaussian Functions", IEEE Signal Processing Letters, Vol.22, No. 1, Jan. 2015.

3. *M. Hansson-Sandsten, "Mean square error optimal weighting for multitaper cepstrum estimation", EURASIP Journal on Advances in Signal Processing, Volume 2013, DOI: 10.1186/10.1186/1687-6180-2013-158, 2013.

4. T. Kinnunen, R. Saeidi, F. Sedlak, K. A. Lee, J. Sandberg, M. Hansson-Sandsten, and H. Li, "Low-Variance Multitaper MFCC Features: a Case Study in Robust Speaker Verification", IEEE Trans. on Speech, Audio and Language Processing, vol. 20, no. 7, 2012. Number of citations:35

5. J. Sandberg and M. Hansson-Sandsten, "Optimal Cepstrum Smoothing", Signal Processing, vol. 92, no. 5, pp. 1290-1301, 2012.

6. J. Sandberg and M. Hansson-Sandsten, "Optimal Non-Parametric Covariance Function Estimation for any Family of Random Processes", EURASIP Journal on Advances in Signal Processing, Volume 2011, Article ID 140797, 2011.

7. *M. Hansson-Sandsten, "Multitaper Wigner and Choi-Williams distributions with predetermined doppler-lag bandwidth and sidelobe suppression", Signal Processing, vol. 91, pp. 1457-1465, 2011.

8. M. Hansson-Sandsten, "Optimal estimation of the time-varying spectrum of a class of locally stationary processes using Hermite functions", EURASIP Journal on Advances in Signal Processing, Volume 2011, Article ID 980805, 2011.

9. M. Hansson-Sandsten and J. Sandberg, "Optimization of weighting factors for multiple window spectrogram of event related potentials", EURASIP Journal on Advances in Signal Processing, Volume 2010.

10. J. Sandberg and M. Hansson-Sandsten, "Optimal Stochastic Discrete Time-Frequency Analysis in the Ambiguity and Time-Lag Domain", Signal Processing, vol. 90, no. 7, pp. 2203-2211, 2010.

11. M. Hansson-Sandsten, "Evaluation of the optimal lengths and number of multiple windows for spectrogram estimation of SSVEP", Medical Engineering and Physics, Vol. 32, No. 4, pp. 372-383, 2010.

12. J. Sandberg, M. Hansson-Sandsten, T. Kinnunen, R. Saeidi, P. Flandrin and P. Borgnat, "Multitaper Estimation of Frequency-Warped Cepstra with Application to Speaker Verification", IEEE Signal Processing Letters, Vol. 17, No. 4, pp. 343-346, 2010. Number of citations:20.

13. J. Sandberg and M. Hansson-Sandsten, "A comparison between Different Discrete Ambiguity Domain Definitions in Stochastic Time-Frequency Analysis", IEEE Trans. on Signal Processing, Vol. 57, No. 3, pp. 868-877, 2009. Number of citations:8

14. P. Jönsson and M. Hansson-Sandsten, "Respiratory sinus arrhythmia in response to fear-relevant and fear-irrelevant stimuli", Scandinavian Journal of Psychology, 49, pp. 123-131, 2008. Number of citations:17.

15. M. Hansson-Sandsten and P. Jönsson, "Multiple Window Correlation Analysis of HRV Power and Respiratory Frequency", IEEE Trans. on Biomedical Engineering, Vol. 54, No. 10, pp. 1770-1779, 2007. Number of citations:16.

16. M. Hansson-Sandsten and J. Axmon, "Multiple Window Cepstrum Analysis for Estimation of Periodicity", IEEE Trans. on Signal Processing, Vol. 55, No. 2, pp. 474-481, 2007.

17. P. Wahlberg and M. Hansson, "Kernels and multiple windows for estimation of the Wigner-Ville spectrum of Gaussian locally stationary processes", IEEE Trans. on Signal Processing, Vol. 55, No. 1, pp. 73-84, 2007. Number of citations:20.

Most cited publications

18. T. Gänsler, M. Hansson, C-J. Ivarsson and G. Salomonsson, "A Double Talk Detector Based on Coherence", IEEE Trans. on Communications, Vol. 44, No. 11, November 1996. Number of citations:123.

19. M. Hansson and G. Salomonsson, "A Multiple Window Method for Estimation of Peaked Spectra", IEEE Trans. on Signal Processing, Vol. 45, No. 3, March 1997. Number of citations:54.

20. T. Kinnunen, R. Saeidi, F. Sedlak, K. A. Lee, J. Sandberg, M. Hansson-Sandsten, and H. Li, "Low-Variance Multitaper MFCC Features: a Case Study in Robust Speaker Verification", IEEE Trans. on Speech, Audio and Language Processing, vol. 20, no. 7, 2012. Number of citations:35

21. M. Hansson, T. Gänsler and G. Salomonsson, "A System For Tracking Changes in the Mid-Latency Evoked Potential during Anesthesia", IEEE Trans. on Biomedical Engineering, Vol. 45, No. 3, March 1998. Number of citations:25.

22. M. Hansson, T. Gänsler and G. Salomonsson, "Estimation of Single Event Related Potentials Utilizing the Prony Method", IEEE Trans. on Biomedical Engineering, Vol. 43, No. 10, October 1996. Number of citations:24.

2. Refereed conference papers

23. *M. Hansson-Sandsten, "Evaluation of non-linear combinations of rescaled reassigned spectrograms", European Signal Processing Conference (EUSIPCO), Lisbon, Portugal, 2014.

24. J. Swärd and J. Brynolfsson and A. Jakobsson and M. Hansson-Sandsten, "Smooth 2-D frequency estimation using covariance fitting", European Signal Processing Conference (EUSIPCO), Lisbon, Portugal, 2014.

25. J. Brynolfsson and M. Hansson-Sandsten, "Multitaper Estimation of the Coherence Spectrum in low SNR", European Signal Processing Conference (EUSIPCO), Lisbon, Portugal, 2014.

26. *J. Brynolfsson and J. Swärd and A. Jakobsson and M. Hansson-Sandsten, "Smooth time-frequency estimation using covariance fitting", Int. Conf. on Acoustics, Speech and Signal Processing, (ICASSP) 2014.

27. M. Hansson-Sandsten and J. Starkhammar, "A refined time-frequency reassignment technique applied to dolphin echo-location signals", Int. Conf. on Acoustics, Speech and Signal Processing, (ICASSP) 2014.

28. M. Hansson-Sandsten, "Matched Gaussian Multitaper Spectrogram", European Signal Processing Conference (EUSIPCO), Marrakech, Morocco, 2013.

29. J. Brynolfsson and M. Hansson-Sandsten, "Optimal Time-Frequency Analysis of Multiple Time Translated Locally Stationary Processes", European Signal Processing Conference (EUSIPCO), Marrakech, Morocco, 2013.

30. M. Hansson-Sandsten, "A Welch method approximation of the Thomson multitaper spectrum estimator", European Signal Processing Conference (EUSIPCO), Bucharest, Romania, 2012.

31. C. Hanilci, T. Kinnunen, R. Saeidi, J. Pohjalainen, P. Alku, F. Ertas, J. Sandberg, M. Hansson-Sandsten, "Comparing spectrum estimators in speaker verification under additive noise degradation", Int. Conf. on Acoustics, Speech and Signal Processing, (ICASSP) 2012. Number of citations:6.

32. M. Hansson-Sandsten, M. Tarka, J. Caissy-Martineau, B. Hansson, D. Hasselquist, "A SVD-based classification of bird singing in different time-frequency domains using multitapers", European Signal Processing Conference (EUSIPCO), Barcelona, Spain, 2011.

33. M. Hansson-Sandsten, "Cross-spectrum and coherence function estimation using time-delayed Thomson multitapers", Int. Conf. on Acoustics, Speech and Signal Processing, (ICASSP) 2011.

34. J. Sandberg and M. Hansson-Sandsten, "Approximate Optimal Periodogram Smoothing for Cepstrum Estimation using a Penalty Term", European Signal Processing Conference (EUSIPCO), Aalborg, Denmark, 2010.

35. M. Hansson-Sandsten, "Multitaper Wigner distribution with predetermined doppler-lag bandwidth and sidelobe suppression", European Signal Processing Conference (EUSIPCO), Aalborg, Denmark, 2010.

36. T. Kinnunen, R. Saeidi, J. Sandberg and M. Hansson-Sandsten, "What Else is New Than the Hamming Window? Robust MFCCs for Speaker Recognition via Multitapering", Interspeech 2010, Makuhari, Japan, 2010, Number of citations:19.

37. M. Hansson-Sandsten and J. Sandberg, "Optimal cepstrum estimation using multiple windows", Int. Conf. on Acoustics, Speech and Signal Processing, (ICASSP), Taipei, Taiwan, April, 2009, Number of citations:12.

38. M. Hansson-Sandsten and J. Sandberg, "Optimization of Weighting Factors for Multiple Window Time-Frequency Analysis", European Signal Processing Conference (EUSIPCO), Glasgow, Scotland, 2009.

39. J. Sandberg and M. Hansson-Sandsten, "Optimal Cohen Class Kernel for TimeFrequency Cross Spectral Estimation of Non-Stationary Processes", European Signal Processing Conference (EUSIPCO), Glasgow, Scotland, 2009.

5. Books

40. G. Lindgren, H. Rootzén and M. Sandsten, "Stationary Stochastic Processes for Scientists and Engineers", to appear 2013, CRC press.

41. M. Sandsten, "Time-Frequency Analysis of Non-Stationary Processes- An Introduction", compendium for the course Stationary and Non-stationary Spectral Analysis, http://www.maths.lth.se/matstat/kurser/masm26/2013/TIMEFREQkompendie.pdf

6. Patents

42. "Method and device for determining and monitoring the degree of narcosis in humans". Patent WO9629928. Patent no. EP0955876. Patent no. EP0955876. Patent no. US5891050. "Sätt och anordning för att bestämma och övervaka graden av narkos hos en människa". Patent no. SE510256. Patent no. SE9501114.

43. "Estimating parameters in telecommunication system". Patent no. SE9403990. "Förfarande för att uppskatta impulssvaret och ekoreturförlusterna i ett telesystem". Patent no. SE514015.

44. "Anordning och förfarande för att uppskatta signalfördröjning". Patent appli. no. SE9403991.

45. "Anordning för att klassificera signaler och kan ingå i ett multimätinstrument". Patent appli. no 9403992.

46. "Multimätinstrument i telesystem". Patent appli. no. 9403993.

47. "Arrangement with measurement system especially for telecommunication system". Patent no. SE9501636. "Anordning och metod i mätsystem för tele- och/eller datakommunikationssystem". Patent no. SE517113.

48. "Anordning och metod för kvalitetsbaserad uppdatering". Patent no. SE9501635. Patent no. SE516757.

Publication list for Dennis Hasselquist

(Number of citations from Web of Science, 19 March 2015)

In total, I have **published 168** international refereed papers **cited 8041** times; my **h-index = 47**

1. Peer-reviewed articles

The five most cited publications

1) Hasselquist, D. Bensch, S. & von Schantz, T. 1996. Correlation between song repertoire, extra-pair paternity and offspring survival in the great reed warbler. **Nature** 381: 229-232. (Number of citations: n = 476)

2) von Schantz, T., Bensch, S., Grahn, M., Hasselquist, D. & Wittzell, H. 1999. Good genes, oxidative stress and radical sexual signals. **Proceedings of the Royal Society, B** 266: 1-12. (Number of citations: n = 426)

3) Råberg, L., Grahn, M., Hasselquist, D. & Svensson, E. 1998. On the adaptive significance of stress-induced immunosuppression. **Proceedings of the Royal Society, B** 265: 1637-1641. (Number of citations: n = 265)

4) Hasselquist, D., Marsh, J.A., Sherman, P.W. & Wingfield, J.C. 1999. Is avian humoral immunocompetence suppressed by testosterone? **Behavioral Ecology & Sociobiology** 45: 167-175. (Number of citations: n = 203)

5) Svensson, E., Råberg, L., Koch, C. & Hasselquist, D. 1998. Energetic costs of immune responses: implications for resource allocation and adaptive immunosuppression. **Functional Ecology** 12: 912-919. (Number of citations: n = 201)

International publications since 2007

6) Waldenström, J., On, S. L. W., Ottvall, R., Hasselquist, D. & Olsen, B. 2007. Species diversity of campylobacteria in a wild bird community in Sweden. **Journal of Applied Microbiology**, 102: 424-432. (Number of citations: n = 35)

7) Madsen, T., Ujvari, B., Hasselquist, D., Nandakumar, K. S. & Holmdahl, R. 2007. Do ”infectious” prey select for high levels of natural antibodies in tropical pythons? **Evolutionary Ecology**, 21: 271-279. (Number of citations: n = 11)

8) Reid, J. M., Arcese, P., Keller, L. F., Elliott, K. H., Sampson, L. & Hasselquist, D. 2007. Inbreeding effects on immune response in free-living song sparrows *Melospiza melodia*. **Proceedings of the Royal Society, London B**, 274: 697-706. (Number of citations: n = 33)

9) Roberts, M. L., Buchanan, K. L., Hasselquist, D. & Evans, M. R. 2007. Effects of testosterone and corticosterone on immunocompetence in the zebra finch. **Hormones & Behaviour**, 51: 126-134. (Number of citations: n = 53)

10) Bensch, S., Waldenström, J., Jonzén, N., Westerdahl, H., Hansson, B., Sejberg, D. & Hasselquist, D. 2007. Temporal dynamics and diversity of avian malaria parasites in a single host species**. Journal of Animal Ecology**, 76: 112-122. (Number of citations: n = 87)

11) Smith, H. G., Råberg, L., Ohlsson, T., Granbom, M. & Hasselquist, D. 2007. Carotenoid and protein supplementation have differential effects on pheasant ornamentation and immunity. **Journal of Evolutionary Biology**, 20: 310-319. (Number of citations: n = 26)

12) Hansson, B., Jack, L., Christians, J. K., Pemberton, J. M., Åkesson, M., Westerdahl, H., Bensch, S. and Hasselquist D. 2007. No evidence for inbreeding avoidance in a great reed warbler population. **Behavioural Ecology**, 18: 157-164. (Number of citations: n = 33)

13) Åkesson, M. Bensch, S. & Hasselquist, D. 2007. Genetic and phenotypic associations in morphological traits: a long term study of great reed warblers *Acrocephalus arundinaceus*. **Journal of Avian Biology**, 38: 58-72. (Number of citations: n = 12)

14) Hellgren, O., Waldenström, J., Perez-Tris, J., Szöllösi, E., Hasselquist, D., Krizanauskiene, A., Ottosson, U. & Bensch, S. 2007. Detecting shifts of transmission areas in avian blood parasites – a phylogenetic approach. **Molecular Ecology**, 16: 1281-1290. (Number of citations: n = 76)

15) Åkesson, M., Hansson, B., Hasselquist, D. & Bensch, S. 2007. Linkage mapping of AFLP markers in a wild population of great reed warblers: importance of heterozygosity and number of genotyped individuals. **Molecular Ecology**, 16: 2189-2202. (Number of citations: n = 26)

16) Perez-Tris, J., Waldenström, J., Hellgren, O., Secondi, J., Bonneaud, C., Hasselquist, D. & Bensch, S. 2007. Within-host speciation of malaria parasites. **PloS One,** 2: e235. (Number of citations: n = 49)

17) Hasselquist, D. Lindström, Å., Jenni-Eiermann, S., Koolhaas, A. & Piersma, T. 2007. Long flights do not influence the immune responses of a long-distance migrant bird: a wind tunnel experiment. **Journal of Experimental Biology**, 210: 1123-1131. (Number of citations: n = 34)

18) Hasselquist, D., Östman, Ö., Waldenström, J. & Bensch, S. 2007. Temporal patterns of occurrence and transmission of the blood parasite *Haemoproteus payevskyi* in great reed warbler *Acrocephalus arundinaceus*. **Journal of Ornithology**, 148: 401-409. (Number of citations: n = 23)

19) Kurtz[†], J., Kalbe, M., Langefors, Å., Mayer, I., Milinski, M. & Hasselquist, D[†]. 2007. An experimental test of the immunocompetence handicap hypothesis in a teleost fish: 11-ketotestosterone suppresses innate immunity in three-spined sticklebacks. **American Naturalist,** 170: 509-519. ([†]*These authors contributed equally to this study.*) (Number of citations: n = 43)

20) Roberts, M. L., Buchanan, K. L., Hasselquist, D., Bennett, A. T. D. & Evans, M. R. 2007. Physiological, morphological and behavioural effects of selecting zebra finches for divergent levels of corticosterone. **Journal of Experimental Biology** 210: 4368-4378. (Number of citations: n = 17)

21) Garvin, J. C., Dunn, P. O., Whittingham, L. A., Steeber, D. & Hasselquist, D. 2008. Do male ornaments signal immunity in the common yellowthroat? **Behavioral Ecology** 19: 54-60. (doi:10.1093/beheco/arm099). (Number of citations: n = 17)

22) Söllözi, E., Hellgren, O. & Hasselquist, D. 2008. A cautionary note on the use of nested PCR for parasite screening – an example from avian blood parasites. **Journal of Parasitology** 94: 562-564. (Number of citations: n = 13

23) Naurin, S., Bensch, S., Hansson, B., Johansson, T., Clayton, D. F., Albrekt, A.-S., von Schantz, T. & Hasselquist, D. 2008. An Affymetrix microarray for large-scale genomic and transcriptional analyses of the zebra finch (*Taenopygia guttata*) and other passerines. **Molecular Ecology Resources** 8: 275-281. (Number of citations: n = 13)

24) Knape, J., Sköld, M., Jonzén, N., Åkesson, M., Bensch, S., Hansson, B. & Hasselquist, D.

2008. An analysis of hatching success in the great reed warbler *Acrocephalus arundinaceus*. **Oikos**, 117: 430-438. (Number of citations: n = 6)

25) Owen-Ashley, N. T., Hasselquist, D., Råberg, L. & Wingfield, J. C. 2008. Latitudinal differentiation of immune defence and sickness behaviour in the White-crowned Sparrow (*Zonotrichia leucophrys*): photoperiodic vs. genetic effects. **Brain, Behaviour & Immunology**, 22: 614-625. (Number of citations: n = 16)

26) Åkesson M, Bensch S, Hasselquist D, Tarka M, Hansson B. 2008. Estimating heritabilities and genetic correlations: comparing the 'animal model' with parent-offspring regression using data from a natural population. **PLoS One**, 3(3): e1739. (doi:10.1371/journal.pone.0001739) (Number of citations: n = 17)

27) Replogle, K., Arnold, A. P., Ball, G. F., Band, M., Bensch, S., Brenowitz, E. A., Dong, S., Drnevich, J., Ferris, M., George, J. M., Gong, G., Hasselquist, D., Hernandez, A.G., Kim, R., Lewin, H., Liu, L., Lovell, P. V., Mello, C. V., Naurin, S., Rodriguez-Zas, S., Thimmapuram, J., Wade, J. & Clayton, D. F. 2008. The Songbird Neurogenomics (SoNG) Initiative: Community-based tools and strategies for study of brain gene function and evolution. **BMC Genomics**, 9: article 131 (doi:10.1186/1471-2164-9-131). (Number of citations: n = 78)

28) Hanssen, S. A., Folstad, I., Hasselquist, D. & Erikstad, K. E. 2008. A label of health: the expression of a female plumage trait signals previous immune challenge. **Biology Letters** 4: 379-381. (Number of citations: n = 14)

29) Yohannes, E., Hansson, B., Lee, R., Waldenström, J., Westerdahl, H., Åkesson, M., Hasselquist, D. & Bensch, S. 2008. Isotope signatures in winter moulted feathers predict malaria prevalence in a breeding avian host. **Oecologia**, 158: 299-306. (Number of citations: n = 17)

30) Hasselquist, D. & Bensch, S. 2008. Daily energy expenditure of singing great reed warblers. **Journal of Avian Biology** 39: 384-388. (Number of citations: n = 17)

31) Hansson, B., Hasselquist, D. Tarka, M., Zehtindjiev, P. & Bensch, B. 2008. Postglacial colonisation patterns and the role of isolation and expansion in driving diversification in a passerine bird. **PLoS One** 3: e2394. (Number of citations: n = 27)

32) Sandell, M. I., Tobler, M. & Hasselquist, D. 2009. Yolk androgens and the development of avian immunity: an experiment in jackdaws (*Corvus monedula*). **Journal of Experimental Biology**, 212: 815-822. (Number of citations: n = 17)

33) Rosivall, B., Söllözi, E., Hasselquist, D. & Török, J. 2009. Effect of extra-pair paternity and sex on nestling growth and condition in the collared flycatcher *Ficedula albicollis*. **Animal Behaviour,** 77: 611-617. (Number of citations: n = 21)

34) Bonato, M., Evans, M. R., Hasselquist, D. & Cherry, M. I. 2009. Male colouration reveals different components of immunocompetence in ostriches (*Struthio camelus*). **Animal Behaviour**, 77: 1033-1039. (Number of citations: n = 11)

35) Söllözi, E., Rosivall, B., Hasselquist, D & Török, J. 2009. The effect of parental quality and malaria infection on nestling performance in the collared flycatcher (*Ficedula albicollis*). **Journal of Ornithology**, 150: 519-527. (Number of citations: n = 5)

36) Bonato, M., Evans, M. R., Hasselquist, D. & Cherry, M. I. 2009. Growth rate and hatching date in ostrich chicks reflect humoral but not cell-mediated immune function. **Behavioural Ecology and Sociobiology**, 64: 183-191. (Number of citations: n = 3)

37) Hanssen, S. A., Bustnes, J. O., Tveraa, T., Hasselquist, D., Varpe, Ø & Henden, J. A. 2009. Individual quality and reproductive effort mirrored in white wing plumage in both sexes of south polar skuas. **Behavioral Ecology**, 20: 961-966. (Number of citations: n = 13)

38) Jenni-Eiermann, S., Hasselquist, D., Lindström, Å., Koolhaas, A. & Piersma, T. 2009. Are birds stressed during long-term flights? A windtunnel study on circulating corticosterone in the red knot. **General & Comparative Endocrinology** 164:101-106. (Number of citations: n = 8)

39) Dunn, P. O., Garvin, J. C., Whittingham, L. A., Freeman-Gallant, C. R. & Hasselquist, D. 2010. Carotenoid and melanin-based ornaments signal similar aspects of male quality in two populations of the common yellowthroat. **Functional Ecology**, 24: 149-158. (Number of citations: n = 21)

40) Naurin, S., Bensch, S., Hansson, B., & Hasselquist, D. 2010. Why does dosage compensation differ between XY and ZW taxa? **Trends in Genetics**, 26: 15-20. (Number of citations: n = 21)

41) Tobler, M., Hasselquist, D., Smith, H. G. & Sandell, M. I. 2010. Short- and long-term consequences of prenatal testosterone for immune function: an experimental study in the zebra finch. **Behavioral Ecology and Sociobiology**, 64: 717-727. (Number of citations: n = 13)

42) Waldenström, J., Axelsson-Ohlsson, D., Olsen, B., Hasselquist, D., Griekspoor, P., Jansson, L., Teneberg, S. Svensson, L. & Ellström, P. 2010. *Campylobacter jejuni* colonization in wild birds: results from an infection experiment. **PLoS One**, 5:e9082. (Number of citations: n = 11)

43) Calsbeek, B., Hasselquist, D. and Clobert, J. 2010. Multivariate phenotypes and the potential for alternative phenotypic optima in wall lizard (*Podarcis muralis*) ventral color morphs. **Journal of Evolutionary Biology**, 23: 1138-1147. (Number of citations: n = 20)

44) Tarka, M., Åkesson, M., Beraldi, D., Hernandez-Sanchez, J., Hasselquist, D., Bensch, S. & Hansson, B. 2010. A strong QTL for wing length on chromosome 2 in a wild population of great reed warblers. **Proceedings of the Royal Society, London B**, 277: 2361-2369. (Number of citations: n = 14)

45) Rosivall, B., Söllözi, E., Hasselquist, D. & Török, J. 2010. Males are sensitive - sex-dependent effect of rearing conditions on nestling growth. **Behavioral Ecology and Sociobiology**, 64:1555-1562. (Number of citations: n = 13)

46) Pap, P. L., Czirjak, G. A., Vagasi, C. I., Barta, Z. & Hasselquist, D. 2010. Sexual dimorphism in immune functions changes during the annual cycle in the house sparrow. **Naturwissenschaften**, 97:891-901. (Number of citations: n = 18)

47) Neto, J. M., Hansson, B. & Hasselquist, D. 2010. Low frequency of extra-pair paternity in Savi's warblers (*Locustella luscinioides*). **Behaviour**, 147: 1413-1417. (Number of citations: n = 5)

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49) Hellgren, O., Krizanauskiene, A., Hasselquist, D. & Bensch, S. 2011. Low haemosporidian diversity and one key-host species in a bird malaria community on a mid-Atlantic island (Sao Miguel, Azores). **Journal of Wildlife Diseases**, 47: 849-859. (Number of citations: n = 7)

50) Naurin, S., Hansson, B., Hasselquist, D., Kim, Y.-H. & Bensch, S. 2011. The sex-biased brain: sexual dimorphism in gene expression in two species of songbirds. **BMC Genomics**, 12:37 (doi:10.1186/1471-2164-12-37). (Number of citations: n = 21)

51) Palacios, M., G., Winkler, D. W., Klasing, K. C., Hasselquist, D. and Vleck, C. M. 2011. Consequences of immune system aging in nature: a study of immunosenescence costs in free-living tree swallows. **Ecology,** 92: 952-966. (Number of citations: n = 13)

52) Asghar, M., Hasselquist, D & Bensch, S. 2011. Are chronic avian haemosporidian infections costly in wild birds? **Journal of Avian Biology**, 42: 1-8. (Number of citations: n = 27)

53) Erlinge, S., Hasselquist, D., Högstedt, G., Seldal, T., Frodin, P. and Svensson, M. 2011. Lemming food-plant interactions, density effects, and cyclic dynamics on the Siberian tundra. **Arctic**, 64: 421-428. (Number of citations: n = 0)

54) Szöllösi E., Cichon, M., Eens, M., Hasselquist, D., Kempenaers, B., Merino, S., Nilsson, J-Å., Rosivall, B., Rytkönen, S., Török, J., Wood, M. J. & Garamszegi, L. Z. 2011. Determinants of distribution and prevalence of avian malaria in blue tit populations across Europe: separating host and parasite effects. **Journal of Evolutionary Biology**, 24: 2014-2024. (Number of citations: n = 19)

55) Westerdahl, H., Asghar, M., Hasselquist, D. & Bensch, S. 2012. Quantitative disease resistance: to better understand parasite-mediated selection on major histocompatibility complex. **Proceedings of the Royal Society, London B**, 279: 577-584. (Number of citations: n = 24)

56) Pala, I., Naurin, S., Stervander, M., Hasselquist, D., Bensch, S. & Hansson, B. 2012. Evidence of a neo-sex chromosome in birds. **Heredity**, 108: 264-272. (Number of citations: n = 11)

57) Asghar, M., Westerdahl, H., Zehtindjiev, P., Ilieva, M., Hasselquist, D. & Bensch, S. 2012. Primary peak and chronic malaria infection levels are correlated in experimentally infected great reed warblers. **Parasitology**, 139: 1246-1252. (Number of citations: n = 10)

58) Pala, I., Hasselquist, D., Bensch, S. & Hansson, B. 2012. Patterns of molecular evolution of an avian neo-sex chromosome. **Molecular Biology & Evolution**, 29: 3741-3752. (Number of citations: n = 5)

59) Nord, A., Chiriac, S., Hasselquist, D. & Nilsson, J.Å. 2012. Endotoxin injection attenuates rest-phase hypothermia in wintering great tits through the onset of fever. **Functional Ecology**, 27: 236-244. (Number of citations: n = 3)

60) Naurin, S., Hasselquist, D., Bensch, S. & Hansson, B. 2012. Sex-biased gene expression on the avian Z chromosome: highly expressed genes show higher male-biased expression. **PLoS One**, 7: e46854. (Number of citations: n = 8)

61) Griekspoor, P., Colles, F., McCarthy, N., Hansbro, P., Olsen, B., Hasselquist, D., Maiden, M. & Waldenström, J. 2013. Marked host specificity and lack of phylogeographic population structure of *Campylobacter jejuni* in wild birds. **Molecular Ecology**, 22: 1463-1472. (Number of citations: n = 10)

62) Hellgren, O., Wood, M. J., Waldenström, J., Hasselquist, D., Ottosson, U. & Bensch, S. 2013. Circannual variation in blood parasitism in a sub-Saharan migrant passerine bird, the garden warbler. **Journal of Evolutionary Biology**, 26: 1047-1059. (Number of citations: n = 3)

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exposure on antioxidant status and bill color in adult zebra finches. **Physiological and Biochemical Zoology**, 86: 333-345. (Number of citations: n = 0)

64) Tolf, C., Grosbois, V., Latorre-Margalef, N., Wille, M., Bengtsson, D., Wallerström, S., Gunnarsson, G., Hasselquist, D., Olsen, B., Elmberg, J. & Waldenström, J. 2013. Individual variation in influenza A virus infection histories and long-term immune responses in mallards. **PLoS One**, 8: e61201. (Number of citations: n = 11)

65) Bonato, M., Evans, M. R., Hasselquist, D., Cloete, S. W. P. & Cherry, M. I. 2013. Ostrich chick immune responses and growth rate are predicted by parental immune responses and parental coloration. **Behavioral Ecology & Sociobiology**, 67: 1891-1901. (Number of citations: n = 1)

66) Lemke, H.W., Tarka, M., Klaassen, R.H.G., Åkesson, M., Bensch, S., Hasselquist, D. and Hansson, B. 2013. Annual cycle and migration strategies of a trans-Saharan migratory songbird: a geolocator study in the great reed warbler. **PLoS One**, 8: e79209. (Number of citations: n = 4)

67) Tarka, M., Åkesson, M., Hasselquist, D. & Hansson, B. 2014. Intralocus sexual conflict over wing length in a wild migratory bird. **American Naturalist**, 183: 62-73. (Number of citations: n = 6)

68) Chiriac, S., Nord, A., Nilsson, J-Å & Hasselquist, D. 2014. Physiological and behavioral responses to an acute phase response in zebra finches: immediate and short-term effects. **Physiological and Biochemical Zoology**, 87: 288-298. (Number of citations: n = 1)

69) Teplitsky, C., Tarka, M., Møller, A. P., Balbontin, J, Hansson, B., Hasselquist, D., de Lope, F., Nakagawa, S., Shroeder, J., Burke, T. A., Mills, J. A., Gustafsson, L., Wheelwright, N. & Charmantier, A. 2014. Assessing multivariate constraints to evolution across ten long-term avian studies. **PLoS One**, 9: e90444. (Number of citations: n = 2)

70) Nord, A., Chiriac, S., Hasselquist, D. & Nilsson, J.Å. 2014. A trade-off between perceived predation risk and energy conservation revealed by an immune challenge experiment. **Oikos**, 123: 1091-1100.

71) Hansson, B., Naurin, S. & Hasselquist, D. 2014. Does inbreeding affect gene expression in birds? **Biology Letters**, 10: article UNSP20140648. (Number of citations: n = 0)

72) Asghar, M., Bensch, S.[†], Tarka, M., Hansson, B. & Hasselquist, D.[†] 2015. Maternal and genetic factors determine early-life telomere length. **Proceedings of the Royal Society, London B**, 282: DOI: 10.1098/rspb.2014.2263. ([†]*These authors contributed equally to this study.*) (Number of citations: n = 0)

73) Rattiste, K., Klandorf, H., Urvik, J., Sepp, T., Asghar, M., Hasselquist, D., Cooey, C. K., & Horak, P. 2015. Skin pentosidine and telomere length do not covary with age in a long-lived seabird. **Biogerontology** (in press). (Number of citations: n = 0)

74) Asghar, M., Hasselquist[1,†], D., Hansson, B., Zehtindjiev, P., Westerdahl, H. & Bensch[†], S. 2015. Hidden costs of infection: chronic malaria accelerates telomere degradation and senescence. **Science**, 347: 436-438. ([1]*Corresponding author.* [†]*These two authors contributed equally to this study.)* (Number of citations: n = 0)

3. Review articles, book chapters

75) Hasselquist, D. 2007. Comparative immunoecology in birds: hypotheses and tests. **Journal of Ornithology,** 148 (Suppl. 2): S571-S582. (Number of citations: n = 35)

76) Hasselquist, D. & Nilsson, J.-Å. 2009. Maternal transfer of antibodies in vertebrates: trans-generational effects on offspring immunity. **Philosophical Transactions of the Royal Society, London B**, 364: 51-60. (Number of citations: n = 96)

77) Hasselquist, D. & Nilsson, J.-Å. 2012. Physiological mechanisms mediating costs of immune responses: what can we learn from studies of birds? **Animal Behaviour**, 83: 1303-1312. (Number of citations: n = 27)

78) Hasselquist, D., Tobler, M. & Nilsson, J.-Å. 2012. Maternal modulation of offspring immune function in vertebrates. In: Eco-Immunology (eds Nelson, R. M. and Demas G.), pp. 165-224. Oxford Univ Press, Oxford. (Number of citations: n = 1)

79) Westerdahl, H., Bensch, S., Nilsson, J-Å., O'Connor, E., Seghal, R., Tesson, S. and Hasselquist, D. 2014. Pathogens and moving hosts. In: Animal movements (eds. Åkesson, S., Hansson, L-A.), pp. 126-148, Oxford Univ Press, Oxford. (Number of citations: n = 0)

6. Popular science articles

85) Bensch, S. & Hasselquist, D. 2011. Trastsångarna i Kvismaren – världens mest utforskade. In: Kvismare Fågelstation 50 år (eds. Nielsen B. and Sondell J.).

34) Hansson B., Montras Janer, T. & Hasselquist, D. 2015. Trastsångarens flyttningsmönster avslöjas med ljusloggar. Fåglar i Kvismaren 30: (in press).

Publications (last 8 years) – Mikael Johansson

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1. Peer-reviewed original articles

1) ***Johansson, M.,** Aslan, A., Bäuml, K.-H., Gäbel, A., & Mecklinger, A. (2007). When remembering causes forgetting: Electrophysiological correlates of retrieval-induced forgetting. *Cerebral Cortex, 17,* 1335–1341.

2) Mecklinger, A., **Johansson, M.**, Parra, M., & Hanslmayr, S. (2007). Source-retrieval requirements affect late ERP memory effects. *Brain Research, 1172,* 110–123.

3) Stenberg, G., Hellman, J., & **Johansson, M.** (2008). The memorability of names and the divergent effects of prior experience. *European Journal of Cognitive Psychology, 20,* 312–345.

4) Stenberg, G., Hellman, J., **Johansson, M.**, & Rosén, I. (2009). Familiarity or conceptual priming – event-related potentials in name recognition. *Journal of Cognitive Neuroscience, 21,* 447–460.

5) Czernochowski, D., Mecklinger, A., & **Johansson, M.** (2009). Age-related changes in the control of episodic retrieval: An ERP study of recognition memory in children and adults. *Developmental Science, 12,* 1026–1040.

6) Olsson, M. J., Lundgren, E. B., Soares, S. C., & **Johansson, M.** (2009). Odor memory performance and awareness: A comparison to word memory across orienting task and retention intervals. *Chemosensory Perception, 2,* 161–171.

7) Stenberg, G., **Johansson, M.**, Hellman, J., & Rosén, I. (2010). "Do you see yonder cloud?"—On priming concepts, a new test and a familiar outcome. Reply to Lucas et al.: "Familiarity or conceptual priming? Good question! Comment on Stenberg, Hellman, Johansson, and Rosén (2009)". *Journal of Cognitive Neuroscience, 22,* 618–620.

8) Treese, A.-C., **Johansson, M.**, & Lindgren, M. (2010). ERP correlates of target–distracter differentiation in repeated runs of a continuous recognition task with emotional and neutral faces. *Brain and Cognition, 72,* 430–441.

9) *Rosburg, T., Mecklinger, A., & **Johansson, M.** (2011). Electrophysiological correlates of retrieval orientation in reality monitoring. *NeuroImage, 54, 3076*–3084.

10) Waldhauser, G. T., **Johansson, M.**, Bäckström, M., & Mecklinger, A. (2011). Trait anxiety, working memory capacity, and the effectiveness of memory suppression. *Scandinavian Journal of Psychology, 52,* 21–27.

11) Treese, A.-C., **Johansson, M.**, & Lindgren, M. (2011). Oh, it's you again: memory interference from irrelevant emotional and neutral faces. *Cognition & Emotion, 25,* 907–915.

12) Rosburg, T., Mecklinger, A., & **Johansson, M.** (2011). Strategic retrieval in a reality monitoring task. *Neuropsychologia, 49,* 2957–2969.

13) *Waldhauser, G. T., **Johansson, M.**, & Hanslmayr, S. (2012). Alpha/beta oscillations indicate inhibition of interfering visual memories. *Journal of Neuroscience, 32,* 1953–1961.

14) Mårtensson, J., Eriksson, J., Bodammer, N., Lindgren, M., **Johansson, M.**, Nyberg, L., & Lövdén, M. (2012). Growth of language-related brain areas after foreign language learning. *NeuroImage, 63,* 240–244.

15) *Waldhauser, G., Lindgren, M., & **Johansson, M.** (2012). Intentional suppression can lead to a reduction of memory strength: Behavioral and electrophysiological findings. *Frontiers in Psychology,* 3:401.

16) Lätt, J., Nilsson, M., Wirestam, R., Ståhlberg, F., Karlsson, N., **Johansson, M.**, Sundgren, P. C., & van Westen, D. (2012). Regional values of diffusional kurtosis estimates in the healthy brain. *Journal of Magnetic Resonance Imaging, 37,* 610–618.

17) Heimann, M., Nordqvist, E., Rudner, M., **Johansson, M.**, & Lindgren, M. (2013). Associative learning measured with ERP predicts deferred imitation using a strict observation only design in 14 to 15 month old children. *Scandinavian Journal of Psychology, 54,* 33–40.

18) *Hellerstedt, R. & **Johansson, M.** (2013). Electrophysiological correlates of competitor activation predict retrieval-induced forgetting. *Cerebral Cortex, 24, 1619–1629.*

19) Rosburg, T., **Johansson, M.**, & Mecklinger, A. (2013). Strategic retrieval and retrieval orientation in reality monitoring studied by event-related potentials (ERPs). *Neuropsychologia, 51,* 557–571.

20) Classon, E., Rudner, M., **Johansson, M.**, & Rönnberg, J. (2013). Early ERP signature of hearing impairment in visual rhyme judgment. *Frontiers in Psychology, 4:241.*

21) Thoresen, C., Endestad, T., Sigvartsen, N.P., Server, A., Bolstad, I., **Johansson, M.**, Andreassen, O., & Jensen, J. (2013). Fronto-temporal hypoactivity during a reality monitoring paradigm is associated with delusions in patients with schizophrenia spectrum disorders. *Cognitive Neuropsychiatry, 19,* 97–115.

22) Johansson, R., & **Johansson, M.** (2014). Look here, eye movements play a functional role in memory retrieval. *Psychological Science, 25,* 236–242.

23) Rosburg, T., **Johansson, M.**, Sprondel, V., & Mecklinger, A. (2014). Retrieving self-vocalized information: An event-related potential (ERP) study on the effect of retrieval orientation. *Brain and Cognition, 92,* 123–132.

24) Robertson, J.A., Thomas, A., Prato, F., **Johansson, M.**, & Nittby, H. (2014). Simultaneous fMRI and EEG during the Multi-Source Interference Task. *PLoS ONE 9(12)*: e114599.

25) Rosburg, T., **Johansson, M.**, Weigl, M., & Mecklinger, A. (2015). How does testing affect retrieval-related processes? - An event-related potential (ERP) study on the short-term effects of repeated retrieval. *Cognitive, Affective, & Behavioral Neuroscience, 15,* 195–210.

26) Nordqvist, E., Rudner, M., **Johansson, M.**, Lindgren, M., & Heimann, M., (2015). Deferred imitation, association learning and communication in 14-month-old children. Behavioral and electrophysiological indices. *Frontiers in Psychology*, 6:260.

27) Svensson, M., Grahm, M., Ekstrand, J., Movahed Rad, P., **Johansson, M.**, & Tingström, A. (in press). Effect of electroconvulsive seizures on pattern separation. *Hippocampus.*

2. Peer-reviewed conference contributions (results not published elsewhere)

1) Elfgren, C., **Johansson, M.**, Olsrud, J., Passant, U., & Van Westen, D. (2008). The role of the medial temporal lobe in the acquisition of semantic memory. *Journal of the International Neuropsychological Society,14(S1),* 292.

2) Waldhauser, G. T., Bovim, T., **Johansson, M.** (2008). Recognition memory impairment after intentional suppression as an all-or-none phenomenon: Electrophysiological evidence. *International Journal of Psychology, 43*(3-4), 815.

3) Bolstad, I. C., Thoresen, C., **Johansson, M.**, Endestad, T., Server, A., Nakstad, P. H., Andreassen, O. A., & Jensen J. (2009). The role of negative emotion in reality monitoring: An fMRI study. *39th Annual Meeting of the Society for Neuroscience, Chicago, USA.*

4) **Johansson, M.**, & Hellerstedt, R. (2011). Selective semantic retrieval induces episodic forgetting: An event-related potential (ERP) approach. *5th International Conference on Memory (ICOM5), York, UK.*

5) Johansson, R., Wengelin, Å., Johansson, V., & **Johansson, M.** (2012). Reading a finished text versus reading your own emerging text. *SIG Writing Conference, Porto, Portugal*.

6) Frid, J., Wengelin, Å., Johansson, V., Johansson, R., & **Johansson, M.** (2012). Testing the temporal accuracy of keystroke logging using the sound card. *SIG Writing Conference, Porto, Portugal.*

7) Sikström, S., **Johansson, M.**, & Waldhauser, G. (2012). The Spike-Time-Dependent Plasticity Model of Retrieval Induced Forgetting. *30th International Congress of Psychology (ICP), Cape Town, South Africa.*

8) Hellerstedt, R. & **Johansson, M.** (2013). Blocking or Inhibition? An ERP Study of the Neural Mechanisms Underlying Retrieval-Induced Forgetting. *13th European Congress of Psychology (ECP 2013), Stockholm, Sweden.*

9) Stiernströmer, E. S. & **Johansson, M.** (2013). Emotion Induced Detection Bias in Working Memory. *13th European Congress of Psychology (ECP 2013), Stockholm, Sweden.*

10) Nordqvist, E., Heimann, M., Rudner, M., **Johansson, M.**, & Lindgren, M. (2013). Long-term declarative memory performance in 14-15 month infants predicts the strength of neural response during associative learning. *16th European Conference on Developmental Psychology (ECDP 2013), Lausanne, Switzerland.*

11) Grahm, M., Svensson, M., **Johansson, M.**, & Tingström, A. (2013). Effect of ECS-treatment on pattern separation ability in rats. *Society for Neuroscience Annual Meeting, San Diego, CA, USA.*

12) Rosburg, T., **Johansson, M.**, & Mecklinger, A. (2014). Neural correlates of retrieval orientation modulated by the order of test conditions. *21th Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, USA.*

13) Bernstrup, S. & **Johansson, M.** (2014). Adopting local or global processing orientation prior to face recognition modulates event-related potential (ERP) old/new effects. *21th Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, USA.*

14) Hellerstedt, R. & **Johansson, M.** (2014). Temporal dynamics of cued recall: An event-related potential study. *21st Annual Meeting of the Cognitive Neuroscience Society, Boston, MA, USA.*

15) Davidson, P., Carlsson, I., Jönsson, P., & **Johansson, M.** (2014). The effect of pattern separation on fear conditioning. *17th World Congress of Psychophysiology (IOP2014), Hiroshima, Japan.*

16) Söderström, P., Horne, M., Mannfolk, P., Shtyrov, Y., **Johansson, M.**, & Roll, M. (2014). Prosody provides cues to morphosyntactic structure: an EEG-fMRI study of neural networks subserving Swedish word tone processing. *Annual Meeting of the Society for the Neurobiology of Language, Amsterdam, Netherlands.*

17) Hellerstedt, R., **Johansson, M.** & Anderson, M.C. (2015). Electrophysiological correlates of memory intrusions. *22nd Annual Meeting of the Cognitive Neuroscience Society, San Francisco, USA.*

18) Rosburg, T., **Johansson, M.** & Mecklinger, A. (2015). Do old/new effects vary with differential reaction times to new and old items in memory exclusion tasks? *22nd Annual Meeting of the Cognitive Neuroscience Society, San Francisco, USA.*

19) Bramão, I. & **Johansson, M.** (2015). The encoding–retrieval match principle and the diagnostic value of the retrieval cue: an event-related potential (ERP) study. *22ndAnnual meeting of the Cognitive Neuroscience Society.*

20) Dewhurst, R., Johansson, R., Bramão, I. & **Johansson, M.** (2015). Eye movements to nothing support memory retrieval in the brain. *22ndAnnual meeting of the Cognitive Neuroscience Society.*

3. Monographs

-

4. Research review articles

-

5. Books and book chapters

-

6. Patents

-

7. Open access computer programs

-

8. Popular science articles/presentations

Radio

- Vetandets Värld i SR P1, 6 april 2005
- UR, om minnet, 27 feb 2011
- Filosofiska rummet, SR P1, Minnets funktion, 30 oct 2011

Papers

- LUM (Lunds universitet meddelar), Nr 2, feb 2005
- Aftonbladet, 27 november 2008
- Sydsvenskan, 30 december 2008

- Aftonbladet - Härligt hemma, 20-21 march 2010
- Dagens Nyheter - Insidan, 23 sept 2010

Television

- Den gränslösa hjärnan/Minnets labyrinter, UR vetenskap
- UR Samtiden

Multimedia

- Holone, http://www.holone.se

Web

- Cognitive Neuroscience Society News, When Gazing Into Nothing Helps Us Remember, http://www.cogneurosociety.org/gazenothing_johansson/
- Lund University Youtube channel, Eye movements boost our memory, http://youtu.be/mIcgab5Psv8?list=UUIzc0kTQRpk7z1CmPnAJzpw

Miscellaneous

- Grubbelklubben/Filosofiska rummet, Moriska paviljongen, Folkets park, Malmö, 24 Oct 2011
- Hjärndagen arranged by Stiftelsen Forskning och framsteg, Stockholms konserthus, 13 Oct 2014

CV

Name: Maria Sandsten	**Doctorial degree:** 1996-03-15
Birthdate: 19661107	**Academic title:** Professor
Gender: Female	**Employer:** Lunds universitet

Research education

Dissertation title (swe)

Dissertation title (en)

On Signal Dependent Basis Functions- Estimation of Event Related Potentials and Multiple Window Spectrum Analysis

Organisation	Unit	Supervisor
Lunds universitet, Sweden Sweden - Higher education Institutes	Elektro- och informationsteknik 107201	Göran Salomonsson

Subject doctors degree	ISSN/ISBN-number	Date doctoral exam
20205. Signalbehandling	ISRN LUTEDX/TETT- -1013- -SE	1996-03-15

CV

Name: Mikael Johansson	**Doctorial degree:** 2002-05-23
Birthdate: 19720918	**Academic title:** Professor
Gender: Male	**Employer:** No current employer

Research education

Dissertation title (swe)

Dissertation title (en)

Memory Illusions and Memory Attributions - Behavioural and Electrophysiological Data

Organisation	Unit	Supervisor
Lunds universitet, Sweden Sweden - Higher education Institutes	Psykologi 253099	Georg Stenberg

Subject doctors degree	ISSN/ISBN-number	Date doctoral exam
50101. Psykologi (exklusive tillämpad psykologi)	91-628-5229-9	2002-05-23

CV

Name: Dennis Hasselquist	**Doctorial degree:** 1994-10-07
Birthdate: 19600715	**Academic title:** Professor
Gender: Male	**Employer:** No current employer

Research education

Dissertation title (swe)

Dissertation title (en)

Male attractiveness, mating tacticsand realized fitness in the polygynous great reed warbler

Organisation	Unit	Supervisor
Lunds universitet, Sweden Sweden - Higher education Institutes	Biologiska institutionen 156400	Torbjörn von Schantz
Subject doctors degree	**ISSN/ISBN-number**	**Date doctoral exam**
10611. Ekologi	91-7105-051-5	1994-10-07

Publications

Name: Maria Sandsten	**Doctorial degree:** 1996-03-15
Birthdate: 19661107	**Academic title:** Professor
Gender: Female	**Employer:** Lunds universitet

Sandsten, Maria has not added any publications to the application.

Publications

Name: Mikael Johansson	**Doctorial degree:** 2002-05-23
Birthdate: 19720918	**Academic title:** Professor
Gender: Male	**Employer:** No current employer

Johansson, Mikael has not added any publications to the application.

Publications

Name: Dennis Hasselquist	**Doctorial degree:** 1994-10-07
Birthdate: 19600715	**Academic title:** Professor
Gender: Male	**Employer:** No current employer

Hasselquist, Dennis has not added any publications to the application.

Register

Terms and conditions

The application must be signed by the applicant as well as the authorised representative of the administrating organisation. The representative is normally the department head of the institution where the research is to be conducted, but may in some instances be e.g. the vice-chancellor. This is specified in the call for proposals.

The signature*from the applicant*confirms that:

- the information in the application is correct and according to the instructions form the Swedish Research Council
- any additional professional activities or commercial ties have been reported to the administrating organisation, and that no conflicts have arisen that would conflict with good research practice
- that the necessary permits and approvals are in place at the start of the project e.g. regarding ethical review.

The signature *from the administrating organisation* confirms that:

- the research, employment and equipment indicated will be accommodated in the institution during the time, and to the extent, described in the application
- the institution approves the cost-estimate in the application
- the research is conducted according to Swedish legislation.

The above-mentioned points must have been discussed between the parties before the representative of the administrating organisation approves and signs the application.

Project out lines are not signed by the administrating organisation. The administrating organisation only sign the application if the project outline is accepted for step two.

Applications with an organisation as applicant is automatically signed when the application is registered.