University of Glasgow

Fully funded Lord Kelvin - Adam Smith PhD Studentship

Recovering the dynamics of talk
Tracking temporal dependence in multilevel models for speech

Applications are invited for a fully funded PhD position (home and international fees) for interdisciplinary work on modelling temporal dependence in multilevel models for speech. The project is funded through the University's prestigious Lord Kelvin – Adam Smith scholarship scheme.

The project would suit a Mathematics or Statistics graduate with a keen interest in linguistics and phonetics, or a linguist or phonetician with an strong interest or background in quantitative methods. The studentship is suitable for candidates with a good first degree or a good Masters degree. The project is fully funded for four years and includes home or international fees, a stipend at Research Council recommended rates (£13,863 for 2014/15) and £5,300 per year for research expenses and conference attendance.

Application deadline: April 22nd, 2014

Project details

Describing the numerous factors that constrain and promote particular aspects of linguistic behaviour in interaction is very difficult, tracking their temporal nature even more so. The recent adoption of more advanced quantitative methods has enhanced the modelling, and so understanding, of linguistic patterns. At the same time, the availability of digital recording and storage capacity is leading to increasingly large corpora of complex linguistic data for such investigations. But amidst the wealth of such data, linguists face a serious analytical challenge. While spoken language corpora typically contain numerous instances of features which recur over time in interactions — language behaviour is dynamic — statistical analyses depend on techniques which aggregate these instances — analyses of language are essentially static. Even newer methods which assume repetition of instances, or recognize complex groupings in the data, are unable to identify and exploit the fundamental contribution of dynamic, recurring, and ordered patterns in language data.

This project begins a collaboration between statistics and linguistics to develop dynamic quantitative models of spoken language data. In linguistics, the tension between large corpora based on comparatively few speakers is eased by using statistical models which can process nested data. The research will go beyond just modelling the complex nested structure of language data to also incorporate the underlying temporal dynamics of speech.

This new form of statistical analysis will not only predict the factors constraining and promoting language patterns, taking account of the speakers who utter them and the words they occur in, but at the same time it will automatically recover crucial information about the temporal nature of language variation, shifting our analytical perspective a step closer to the dynamics of talk.

The student will develop a statistical model to analyse specific aspects of language (e.g. phonology, lexicon) using data from the electronic real-time corpus of Glaswegian vernacular, Sounds of the City. The corpus is a searchable, multilayered, database of 58 hours of 136 speakers, recorded between 1970 and 2010, with orthographic transcripts and automatically phonemically segmented waveforms, amenable to automatic acoustic analyses of durational (e.g. segment durations) and resonance characteristics of speech (e.g. formant measures from FFT spectral analysis). The corpus software, LABB-CAT, is open source and can be flexibly adjusted by the programmer, both to meet the needs of, and benefit from the results of, the project.

This project initiates a programme to develop statistical models which account for the complex nested structure, and the underlying dynamics, of language. Analysing linguistic data generally uses random-effects models to account for the correlation of data within speakers and words, and to avoid biasing the inference (overestimation of p-values, inefficient weighting of the data). Such models have two important drawbacks: they ignore temporal and contextual aspects of speech, and they only allow inference about the mean effects, failing to recover more complex aspects, such as multimodality and unobserved groupings.

The cornerstone of the statistical analysis will be the combination of a random effects model (to accurately represent nested data structures) and a hidden Markov model (to represent temporal dynamics and grouping structures). In a hidden Markov model, an unobserved ("hidden") variable is introduced to track temporal dependency and context. Previous researchers have modelled the time course of features by manually coding, but such procedures are extremely time-consuming and difficult to automate, thus not scaling well to large corpora. Some context information might however be available, so the "hidden" state is actually not fully "hidden", requiring a "semi-supervised" model. The assumption of Gaussianity of the random effects might also not be realistic, requiring non-parametric random effects.

Recursive predictive modelling, such as HMM, is the basis of most speech recognition systems, which are used to automatically parse and segment language corpora. However these typically do not include random effects to model the nested structure of most datasets of this kind. Using a HMM-based model for the work of this project has another potential outcome, specifically to improve HMM speech and language parsers themselves, by combining two stages of analysis into a single step, leading to improved efficiency and correct propagation of uncertainty.

Research training and student experience

The first year will entail a substantial period of research training across both disciplines. For statistics, the student will take courses offered by the Scottish Mathematical Sciences Training Centre (SMSTC) and the Academy for PhD Training in Statistics (APTS), undertake the generic skills and employability training offered by the University, and participate in postgraduate away-days which provide general research training, such as thesis writing in LaTeX and computational skills. They may also take courses offered as part of the newly-developed Masters programmes in Statistics. English Language is recognized as a provider of excellent research training in Language Sciences and Social and Applied Linguistic Investigations Pathways for the ESRC Doctoral Training Centre (DTC) for Scotland. The scholar's core training in phonetics and linguistics within English Language will be enhanced with the additional resources from the DTC.

The scholar will be based in the School of Mathematics and Statistics, and will benefit from an active and vibrant research environment which includes weekly seminars, School colloquia, visits by researchers of high international standing and opportunities for overseas research visits and participation in international workshops and conferences. They will also be a full member of the Glasgow University Laboratory of Phonetics, whose new location nearby will allow them to fully benefit from the lively research group based there. As for previous KS projects, we envisage the scholar's supervision to take place through a series of plenary supervisions, and regular subject-specific supervisions.

How to apply

Please send your application, before April 22nd, 2014, by email to `ludger.evers@glasgow.ac.uk`.

Please include the following in your application.

- a cover letter of two pages explaining why you are interested in the project and indicating what skills and ideas you would contribute to the project;
- an up-to-date curriculum vitae;
- two references from academics who know the applicant's work well;
- evidence of first degree work which is a good Upper Second Class or First Class standard, or equivalent (mainly A grades);
- certification of proficiency in English (where relevant).

We anticipate to hold interviews in the week starting May 5th, 2014.

Informal enquiries

For further information, please contact any member of the project team.

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