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SIMULATING INTONATIONAL VARIETIES OF SWEDISH

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ABSTRACT

This paper introduces a new research project Simulating Intonational Varieties of Swedish (SIMULEKT). The basic goal of the project is to produce more precise and thorough knowledge about some major intonational varieties of Swedish. In this research effort the Swedish prosody model plays a prominent role. A fundamental idea is to take advantage of speech synthesis in different forms. In our analysis and synthesis work we will focus on some major intonational types: South, Göta, Svea, Gotland, Dala, North, and Finland Swedish. The significance of our project work will be within basic research as well as in speech technology applications.

Keywords: intonational varieties, Swedish, prosody model, simulation, speech synthesis.

1. INTRODUCTION

Simulating Intonational Varieties of Swedish (SIMULEKT) is a three year research project funded by the Swedish Research Council. The object of study is the prosodic variation characteristic of different regions of the Swedish-speaking area, and a main methodology to be used in the project work is speech synthesis. It is quite apparent that prosody is a fundamental constituent of the different, native accents characterizing the distinct regional varieties of Swedish [2, 3]. The main regional varieties or dialect groups are South, Göta, Svea, with Dala as a distinct subgroup, Gotland, North, and Finland Swedish.

We have a fair degree of knowledge about the prosody of some of these regional varieties, like Svea and South Swedish, while other varieties like North and Finland Swedish have been much less studied. Moreover we know more about the prosodic variation at the word level, such as pitch patterns of word accents, and markedly less about the phrase and utterance prosody of the different regional varieties.

Thus we regard it as an important research task to study in more detail the prosody and intonation of the main regional varieties of Swedish. In this study the Swedish prosody model has a prominent role to play. A basic idea of our project work is to employ simulation of prosody by means of speech synthesis in different forms in order to be able to understand better the prosodic variation of Swedish.

2. PROJECT GOALS

The basic aim of the research project is to attain more precise and thorough knowledge about prosody and intonation of the main regional varieties of Swedish. That prosody is assumed to vary regionally between these dialect groups does of course not exclude the possibility that there is prosodic variation within a regional variety. However, such internal variation is assumed to be markedly less than the prosodic variation between the dialect groups. It is also part of our aim to be able to factor out what belongs specifically to the native accent of an intonational variety and what represents other expressive or paralinguistic prosody.

An accompanying goal in our project work is to develop the Swedish prosody model theoretically and experimentally. The ultimate goal of the project and the test of success in our analysis is to be able to simulate convincingly the major intonational varieties of Swedish by means of speech synthesis.

3. THE SWEDISH PROSODY MODEL

The Swedish prosody model [3, 4] has been influential in the development of intonational phonology [12, 13, 14]. In the original prosodic typology for Swedish dialects [3] a fundamental division into word prosody and sentence prosody was made. The main features of the typology were the pitch realization of focus and the pitch gestures of word accents, specifically their timing represented as HL in relation to the stress. Recent

developments of the prosody model with relevance for our project are described in [1, 2]. In the latter paper an attempt has been made to update and revise the Swedish prosody model by presenting a tentative typology in the form of a taxonomy of intonational varieties of Swedish (see Table 1).

Table 1: Tentative taxonomy of intonational varieties of Swedish (*dist.* = distinct(ion)).

Prosodic feature:	*Intonational variety:* *South*	*Göta*	*Gotl-Dala*	*Svea*	*Norrl*	*Finl*
Timing characteristics of word accents	late	early	late	early	late	no dist.
Pitch patterns of compound vs. simplex words	same	same	dist.	dist.	dist.	same
Intonational prominence levels	one	two	one	two	one	one
Concatenation patterns (phrase/ compound)	low	up	down/ high	high/ low	down/ low	low

In the revised typology, features of post-lexical prosody and particularly intonational features are emphasized. Intonational prominence plays a major role. Varieties of Swedish divide into two distinct groups depending on whether or not they make a clear distinction between focal and non-focal accentuation. The first group consisting of Svea and Göta types makes such a clear distinction (two levels of intonational prominence), while the second group consisting of South, Gotland-Dala, North and Finland Swedish does not. These dialect types have instead equal prominence of accented words within a phrase (one level of intonational prominence). The first group is also characterized by early word accent timing, while the second group has relatively late word accent timing. This major split of intonational varieties of Swedish conforms to the classical division into 'single-peaked' (South, Gotland-Dala, North, Finland Swedish) and 'double-peaked' dialect types (Svea, Göta) [8]. It also strengthens the view that Svea and Göta varieties form a coherent geo-linguistic unit, while the other varieties fall outside the central axis.

Pitch patterns of compound words divide the dialect types differently. Some varieties make an intonational distinction between compound and simplex words (Svea, Gotland-Dala, North), while the other varieties (South, Göta, Finland Swedish) do not make such a distinction. Finally we suggest that concatenation patterns between prominent accents of a phrase display systematic differences between intonational varieties of Swedish.

We believe that patterns of concatenation should be given more attention in intonational descriptions. This would appear to be true particularly when we attempt to characterize intonational varieties of a language. We can identify four principally distinct ways of concatenation or interpolation: high plateau, low plateau, upslope, and downslope. It takes some distance in terms of unstressed syllables between two accented words for these patterns of concatenation to become observable. Examples of the four types of concatenation patterns between two prominent words of a phrase are shown in Figures 1-4.

Figure 1: Example of a low plateau concatenation pattern, South Swedish speaker.

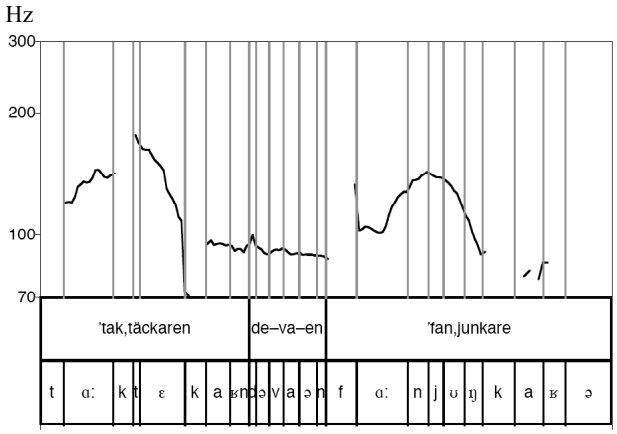


Figure 2: Example of a high plateau concatenation pattern, Svea speaker.

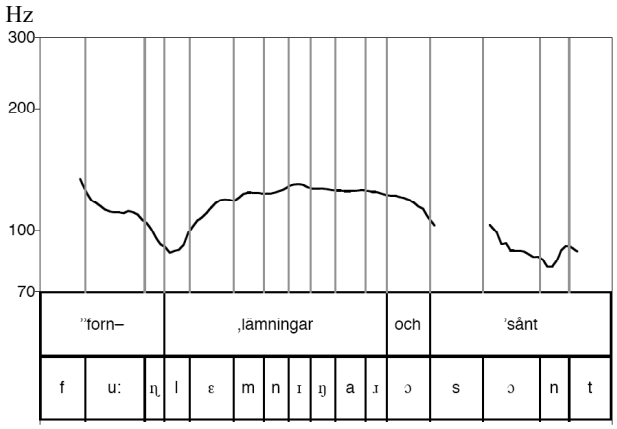


Figure 3: Example of an upslope concatenation pattern, Göta speaker.

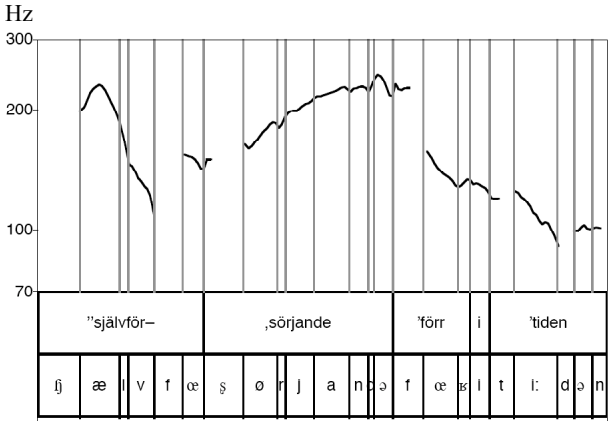
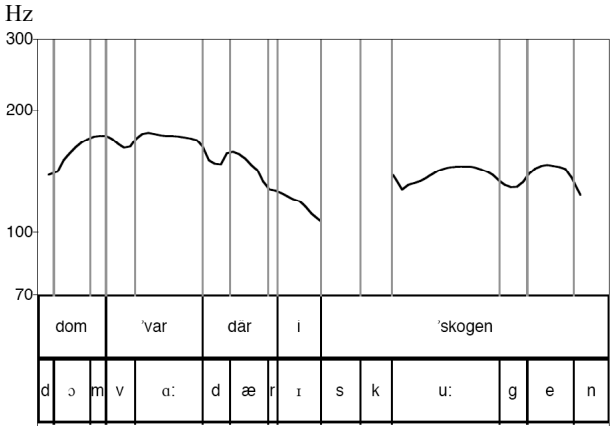


Figure 4: Example of a downslope concatenation pattern, North Swedish speaker.



4. SPEECH MATERIAL

The primary source for data analysis in the project will be the speech database collected in the research project SweDia 2000, but we will also make use of the telephone database SpeechDat.

Within the project The phonetics and phonology of the Swedish dialects around the year 2000 (SweDia 2000), supported by the Bank of Sweden for the period 1998-2003, a fairly large speech material was collected intended mainly for phonetic research [7]. The database contains recordings from more than 100 different places in Sweden and Swedish-speaking parts of Finland with minimally 12 speakers from each place (younger and elderly men and women). From this database a minor, elicited prosody material and primarily the extensive spontaneous speech material will be relevant for our present project work.

In the EU project SpeechDat, KTH as the Swedish partner was responsible for the collection and labeling of recordings by 5000 speakers with a good coverage of the different dialect groups [6]. The primary aim of this database is to serve as reference data for speech recognition, but all speakers also recorded two extra utterances, which were specifically designed for phonetic and prosodic analysis. In our project work, we will take advantage of these 10000 utterance tokens for studying prosodic variation within and across regional varieties.

5. METHODOLOGY

The main part of our project work will consist of the analysis and description of the prosodic patterns, characteristic of varieties of Swedish, as well as the simulation of the prosody of these varieties by means of speech synthesis. In our work the prosody model sketched above and features that are central, like pitch patterns of word accents, and accentuation and phrasing at the utterance level, will play a key role. This reflects our assumption that it is among these prosodic features that we are likely to find the essential characteristics of an intonational variety.

In describing internal variation of intonation within a language we can find inspiration from the results of the so-called IViE project (Intonational Varieties in English) dealing specifically with British English [10, 11].

5.1. Data analysis

In our analysis of the prosody and intonation of varieties of Swedish we need to be selective. As indicated in the introduction our hypothesis is that dialectal variation of prosody in Swedish is regional rather than local. Therefore the idea is to concentrate on some major intonational varieties like South, Göta, Svea, Gotland, Dala, North, and Finland Swedish. We are of course aware of the possibility that this may not be the definite set of intonational varieties of Swedish. It should be emphasized, however, that our aim in this project is not to cover all intonational varieties of Swedish but rather to be able to capture the essential features of some major types.

In our project work we will mainly be exploiting well established phonetic methodology. In the processing of speech data we will use both auditory analysis in the form of a prosodic transcription to identify features such as stress,

accentuation and phrasing as well as regular acoustic-phonetic analysis of these prosodic features. We also intend to use data-driven clustering techniques of the SpeechDat data in order to be able to identify relevant categories.

5.2. Speech synthesis

In addition to regular analysis of speech data for identifying characteristic features of an intonational variety as described above, synthesis of prosody and intonation represents a powerful method for achieving precise knowledge of such features. Gaps in our knowledge will be immediately revealed, and we will get a clearer picture of what may be the essential prosodic characteristics of a variety.

The synthesis part of the project is based on the analysis part and involves simulating – in terms of the parameters of the prosody model – the different intonational varieties and experimenting with the model. The analysis and synthesis parts will be recurring alternatingly in the project work.

Simulating dialectal variation and in particular prosodic variation within a language through speech synthesis is a rarely used methodology. However, some main varieties of English like British, American and Australian English have been synthesized in this way. Speech synthesis for Swiss German along with Standard German is also under development [15]. It is striking, though, that some recent research projects aiming at the description of prosodic varieties of a language, like British English [10, 11], German [9] and Norwegian [5] have not included speech synthesis as a research method.

We have recourse to some main types of speech synthesis, which are suited for different phases in the project work. During the exploratory phase, the editing and resynthesis of recorded speech will be exploited (PSOLA). Another type of speech synthesis to be used later in the project is rule-based formant synthesis, where all aspects of speech can be modeled explicitly. We will also take advantage of hybrid methods where prosody will be rule-governed, while the segmentals of speech come from natural speech.

6. SIGNIFICANCE OF THE PROJECT

The significance of our project work will be both within basic research and within speech technology applications. Thus our project is expected to contribute to deepening our understanding of prosodic structuring of spoken language generally, and more specifically of dialectal variation of Swedish. It is likely to contribute to generating new knowledge about prosody to be used in speech synthesis systems. With its aim to be able to simulate different accents of a language the present project has the potential of becoming a pioneer enterprise generally within the field of synthetic speech.

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