SNOBOL-Tone (ST) -
A Sound Pattern-Matching Programming Language

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Abstract
The proposed programming language, SNOBOL-Tone, performs sound matching in a given sound stream. This is analogous to pattern-matching of substrings in a given string, as is done in the SNOBOL language [1]. One way to perform the SNOBOL-Tone pattern matching of a spoken text is to transcribe the text into written text followed by regular SNOBOL pattern matching [2]. However, when the sound stream is not a spoken stream another solution is needed. SNOBOL-Tone is designed to provide such a solution. SNOBOL-Tone integrates three scientific domains:

1. Computer science – creating compilers and interpreters;
2. Electronic engineering – building filters of various frequencies;

Examples of SNOBOL-Tone Applications:

1. A tool for developing smartphone applications;
2. A diagnostic tool for measuring heart functions;
3. Aircrafts recognition by their engine noise;
4. Stammering purification – removal of the stammering to produce normal speech.

Keywords:

1. Introduction

SNOBOL-Tone is a Domain Specific Language (DSL) for the specific purpose of treating tones, sounds and signals [5]. Another language that has a similar function is CSound [6]. Csound is a computer programming language for sound, also known as a sound compiler or an audio programming language, or more precisely, an audio DSL. It is called Csound because it is written in C, as opposed to some of its predecessors.

2. SNOBOL Concepts

SNOBOL [1] is a string pattern matching programming language based on a single statement:

\[
(1) \ <label> : <subject> <pattern> = <object> :S(label1)F(label2)\]

In which the subject is searched for a substring fulfilling the constraints defined by the pattern, and then this subject is substituted by the object. In case of a successful pattern matching the next executed statement is located in the label lebel1, otherwise label2.

3. SNOBOL-Tone Language

SNOBOL-Tone is a tone pattern matching programming language, an extension of the SNOBOL string pattern language. Fig.1 is a simple program that demonstrates SNOBOL-Tone. The statement definitions of the extended languages look very similar to SNOBOL, but the significance of the variables
is different. Whereas in regular SNOBOL, the variables generally represent a string, namely a stream of characters, in the SNOBOL-Tone they stand for a stream of values, i.e. function values such as sound.

This stream of a one variable function can be matched with the help of auxiliary functions treating other function properties, such as frequency, extreme values etc. The input and output streams may be described visually as a graph thus increasing the program’s readability.

![Tone Pattern Matching Code-example](image)

**Fig. 1: SNOBOL-Tone sample program**

### 4. SNOBOL-Tone (ST) System

The SNOBOL-Tone (ST) System consists of modules serving various programming languages: SNOBOL-Tone (ST) and the host language, MATLAB (see the block diagram in Fig. 2).

Blocks 4 and 5 in Fig. 2 are relevant to the tone treatment. Block 3 treats the ST built in functions such as Peak_Amplitude, which searches for the maximal amplitude; Frequency (lower_limit, upper_limit) which gives the frequencies function between two limits and Peaks_Number (interval) which gives the number of peaks in the interval. Block 4 represents a module that performs DFFT - Digitalized Fast Fourier Transform on a given interval for further usage.

### 5. Theoretical Background

The mathematical tools for ST are mainly based on digitalized fast Fourier transformations which transforms a function to the frequency domain, and on wavelet series which approximates the analyzed signal. In order to increase the algorithm’s efficiency, a multi-level adaptive technique (MLAT) methodology can be used [4].

### 6. Discussion

SNOBOL was chosen as the basic language; however, there were other possibilities such as the Perl [5] and Python [6] programming languages because of their concise and elegant definitions. There are also some audio manipulation packages available on the market such as Csound and audio DSL [7] and [8]), but their flexibility is rather limited.
7. Conclusions

The SNOBOL-Tone programming language has a wide spectrum of applications in audio processing and in signal processing. It can be easily utilized in applications such as seismographs, heart monitors, and polygraph analysis.

SNOBOL-Tone analogically develops the string-matching and tree-matching [2], using tone-matching or generally speaking the signal-matching; its theoretical infrastructure is given in [9] and [10].

8. References