MIMIC in the OMOP Common Data Model*

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This paper discusses the implementation of spectral delay using filters comprising a cascade of many low-order allpass filters and an equalizing filter. The spectral delay filters have chirp-like impulse responses causing a large, frequency-dependent delay that is useful in audio effects processing. An equalizing filter design and a multirate technique, which stretches the allpass filters, impulse response, are introduced.

0 INTRODUCTION

All those databases do have their own dedicated model. Their structural model are all based on relational database but all do have tables and columns with different meaning and different granularity. As an example MIMIC do have two inputevents tables reflecting its source center changed its EHR. Also their conceptual model are mostly different. For example MIMIC do have ICD9 for condition terminology, while french database CUBREA do have both CIM9 and CIM10. A lot of research have been made on each of these databases independently. While some studies have shown that results are not replicable from one to another database [1] and that keeping the local conceptual model [2] and structure [3] of database for research leads to better outcomes, a dozen of common data model (CDM) have emerged.

i2b2/SHRINE is a medical cohort discovery tool used in more than 200 hospitals over the world. SHRINE is one of the attempt to federate multiple instances of i2b2. The i2b2 star schema has proven its high flexibility thanks to the modular design of the fact tables allowing storing numerics, characters or concepts. Its single terminology model is a path based hierarchical table does not allow to modelise graph ontology (such snomed). While i2b2 is highly efficient for cohort discovery, it's model wasn't designed for ad-hoc analysis. The n*n terminology mapping initiated in SHRINE has been described time consuming and inefficient.

Fast Healthcare Interoperability Resources (HL7-FHIR) is a medical data exchange API specification. FHIR provides a structural CDM that can be materialized as JSON, XML or RDF format. FHIR is flexible and does not specify a standard conceptual model so that each hospital can add extension to implement specific data or share within it's local terminology making each FHIR implementation sensibly divergent. While some research show it as a promising CDM for ad-hoc analysis [4] or cohort discovery [5], its graph nature adds a layer of transformation making usage complicated for data-scientists as well as difficult to create standardized analysis.

Observational Medical Outcomes Partnership Common Data Model (OMOP) is a CDM designed for multicentric Drug adverse Event and now enlarges to medical, clinical and also genomic use cases. OMOP provides both structural (as as set of relational tables) and conceptual (as a set of standard terminologies) such SNOMED for diagnoses, RxNORM for drug ingredients and LOINC for laboratory results. While OMOP has proven its fiability [6] the fact that concept mapping process is known to have impact on results [7] and that applying the same protocol on different data sources leads to different results [1] reveals the importance of keeping the local codes to allow local analysis. Several example of transforming databases into OMOP have been published [8, 9] and yet OMOP stores 682 milion patients records from all over the world[10].

Compared to PCORnet CDM, OMOP (6) : - performes best in the evaluation database criteria compared with the other models (and PCORnet in particularly) : completeness, integrity, flexibility, simplicity of integration, and implementability. - seems to accommodates the broadest coverage of standard terminologies. - provides more systematic analysis with analytic library and visualizing tools from OMOP community : ACHILLES - provides easier SQL models

FHIR: - does specify a common structural model - does not specify a common terminology model, for most of the attributes - has the descendent of HL7, it primary goal is data sharing at low granularity (eg: patient, device level) - implementation may vary substancialy from one to other

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instance - XML and JSON are both not optimized in a computational or user friendly to make queries - API on production EHR are not able to export large amount of data while some work are in the process (FHIR bulk export) - transformation from FHIR dataset to datascientist ready to process dataset may be one ETL per instance

OMOP shares the advantages of all above models. It allows local analysis with raw values, and local terminologies as it stores. It adds values by using a simple and common structural model. It allows standard analysis when needed, and makes possible to compare. However, question still are: - how transforming real datasets to OMOP is complicated - how much dataset lose information - how performances are affected - how well OMOP handle ICU database specificities

We limited the candidate data models to those designed and used for clinical researches, and those freely available in the public domains without restrictions. Filtering an audio signal with an allpass filter does not usually have a major effect on the signal's timbre. The allpass filter does not change the frequency content of the signal, but only introduces a phase shift or delay. Audibility of the phase distortion caused by an allpass filter in a sound reproduction system has been a topic of many studies, see, e.g., [11], [12]. In this paper, we investigate audio effects processing using high-order allpass filters that consist of many cascaded low-order allpass filters. These filters have long chirp-like impulse responses. When audio and music signals are processed with such a filter, remarkable changes are obtained that are similar to the spectral delay effect [13], [14].

1 CHIRP-LIKE IMPULSE RESPONSES AND GROUP DELAY

Filtering an audio signal with an allpass filter does not usually have a major effect on the signal's timbre. The allpass filter does not change the frequency content of the signal, but only introduces a phase shift or delay. Audibility of the phase distortion caused by an allpass filter in a sound reproduction system has been a topic of many studies, see, e.g., [11], [12]. In this paper, we investigate audio effects processing using high-order allpass filters that consist of many cascaded low-order allpass filters. These filters have long chirp-like impulse responses. These filters have long chirp-like impulse responses. These filters have long chirp-like impulse responses. When audio and music signals are processed with such a filter, remarkable changes are obtained that are similar to the spectral delay effect [13], [14].

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$$A(z) = \frac{a_1 + z^{-1}}{1 + a_1 z^{-1}}, \tag{1}$$

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$$\tau_{\mathrm{g,max}} = \begin{cases} \tau_{\mathrm{g}}(0) = \frac{1-a_1}{1+a_1}, \text{when } a_1 \leq 0 \\ \tau_{\mathrm{g}}(\pi) = \frac{1+a_1}{1-a_1}, \text{when } a_1 > 0. \end{cases} \tag{2}$$

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[1] This point is emphasized by Loewer, see esp. p. (610).

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1) Green–function determined experimentally and published.
2) Black–function determined using similarity searches and published.
3) Red–function determined using similarity searches and determined in this study.
4) Blue–O-antigen structure unknown. Function determined using similarity searches and proposed in this study.

Table 1. Active sites and allosteric sites of the GNE MNK enzyme

Excerpt No.	Genre	Spatial Mode	Corrlation
1	Pop	FB	94%
2	Classical	FB	33%
3	Jazz	FF	76%
4	Arabian	FF	41%
5	GNE	H220	45%
6	GNE	H45	93%
7	MNK	G416	74%
8	MNK	D413	72%
9	MNK	R420	94%
10	MNK	N516	91%

Note. This table does not include sentence enhancement statutes. This table does not include sentence enhancement statutes.

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$$\tau_g(\omega) = -\frac{d\phi(\omega)}{d\omega}.$$

Audibility of the phase distortion caused by an allpass filter in a sound reproduction system has been a topic of many studies, see, e.g., [11], [12]. In this paper, we investigate audio effects processing using high-order allpass filters that consist of many cascaded low-order allpass filters. These filters have long chirp-like impulse responses. When audio and music signals are processed with such a filter, remarkable changes are obtained that are similar to the spectral delay effect.

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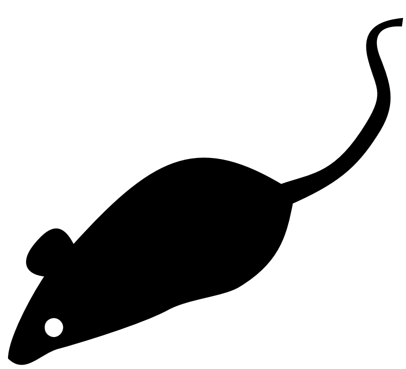

Fig. 1. The spectral delay filter consists of M allpass filters and an equalization filter.

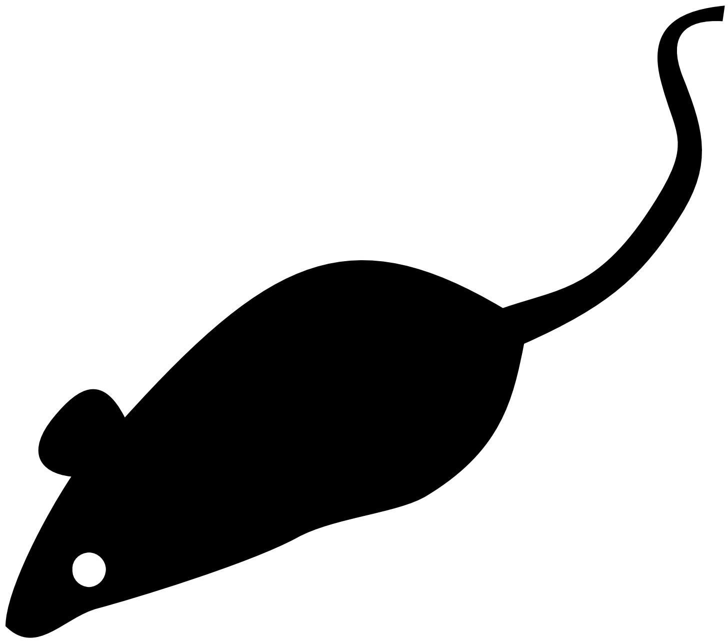

Fig. 2. This paper is organized as follows. In Section 1, we discuss the group delay of a cascade of first-order allpass filters and its relation to the chirp-like impulse response of the spectral delay filter. Furthermore, a multirate method to stretch the impulse response of the spectral delay filter is proposed. Section 2 discusses the amplitude envelope of the impulse response and suggests a design method for the equalizing filter. Section 3 presents application examples using the spectral delay filter. Section 4 concludes this paper.

d) Blue–O-antigen structure unknown. Function determined using similarity searches and proposed in this study.

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Example 1. In this paper, we investigate audio effects processing using high-order allpass filters that consist of many cascaded low-order allpass filters. These filters have long chirp-like impulse responses.

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2 SUMMARY

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3 CONCLUSION

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4 ACKNOWLEDGMENT

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$$\phi(\omega) = -\omega + 2\arctan\left(\frac{a_1 \sin\omega}{1 + a_1 \cos\omega}\right) \tag{1}$$

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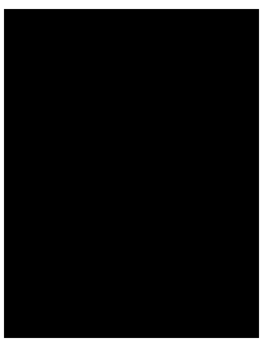
NOMENCLATURE

a_c = condensation coefficient condensation coefficient condensation coefficient

TLR = Toll-like receptor

PAMPs = pathogen-associated molecular patterns condensation coefficient condensation

THE AUTHORS



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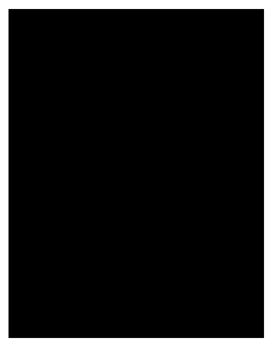

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