[[1]](#footnote-1)

Preparation of Papers for IEEE TRANSACTIONS and JOURNALS

First A. Author, Second B. Author, Jr., and Third C. Author, Member, IEEE

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*Index Terms*—About four key words or phrases in alphabetical order, separated by commas. For a list of suggested keywords, see attached file.

# INTRODUCTION

T

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# Segmentación Temporal de Notas Musicales

## Concepto de Segmentación – Onset – Offset

La Segmentación temporal en las notas musicales hace referencia a la detección de intervalos temporales en donde se manifiesta una señal de audio con un pitch característico, es decir, una nota musical. La Segmentación conlleva dos eventos los cuales son el “onset” y “offset”.

El evento de onset es el cual determina el comienzo de la nota musical. Este puede se manifiesta mediante un cambio abrupto en la energía de la señal de audio, o lo que también se conoce como “attack”.

Por otro lado, el offset es el evento que determina la finalización de la nota. El hecho de que la nota musical finalice, es análogo a decir que la energía de la señal de audio no es distinguible de la energía del ruido del ambiente sonoro.

Habiendo aclarado el significado de estos conceptos se procederá a continuación a presentar un esquema que se puede utilizar para llevar a cabo la segmentación, para luego abordar la realización de lo propuesto en dicho esquema.

## Etapas de la Segmentación

Si es posible detectar tanto el evento de onset como el de offset, entonces se tendrá el intervalo temporal en el cual se manifiesta la nota musical, ya que se tendrá el comienzo y el final de este. Entonces como primera medida se proceden a hallar estos dos eventos.

En cuanto al evento de offset, este será después del evento de onset. Suponiendo que se tiene el onset, de manera sencilla se puede detectar el offset identificando el momento para el cual la señal de audio es comparable con la señal de ruido (mediante un “threshold” de offset, por ejemplo), comenzando la búsqueda de este instante a partir del evento de onset.

Dicho esto, se puede considerar a la segmentación como principalmente un problema de detección de onset. Esto se abordará mediante el procedimiento empleado por la mayoría de los algoritmos de detección de este tipo de eventos.

En la Fig. (¿?) se ilustra el diagrama para abordar el problema mencionado, el cual consta de la generación de una señal de detección (también llamada señal de novedad) y la posterior detección de los picos de esta. El instante (temporal) de detección de los picos es también el instante de onset. Además, para generar la función de novedad mencionada, podría procesarse la entrada original de audio preparándola para generar una función de novedad que podría ser más efectiva (“pre-procesamiento”) o también puede procesada la señal de detección de manera que se logre mayor eficiencia en la detección de picos (“post-procesamiento”).

FIGURA 1 FLACOOOOOOOOOOOO

## Función de Detección

El algoritmo de generación de la función de detección es determinante para la detección de offset. Un algoritmo efectivo tanto para señales de audio armónicas e inarmónicas (las señales emitidas por instrumentos de percusión, por ejemplo, son inarmónicas) es introducido en (Masri 1996) construye una función de novedad de alto contenido armónico (“High Frequency Content” o “HFC”) sumando valores linealmente ponderados de las magnitudes espectrales de la siguiente manera:

En la anterior ecuación la función ponderada en módulo es la “Short Time Fourier Transform” (STFT). La función de detección enfatiza las zonas de la señal que presenta alto contenido armónico, cambiando bruscamente en el tiempo.

Un algoritmo tratado en (Bello, Duxbury, Davies y Sandler, 2004) que se concentra más en las variaciones armónicas es el de “diferencia espectral” (“Spectral Diference” o “SD”) y obtiene la función de detección de la siguiente manera:

En la ecuación, la derivada de la STFT con respecto a “n” representa la diferencia entre bines de la magnitud espectral de las muestras sucesivas.

A esta focalización en la diferencial espectral puede incorporarse un análisis tratado en [1] sobre el cambio de fase de la señal de audio. Combinando estos dos aspectos, de cambio espectral en magnitud y de fase se logra la siguiente función de detección:

En donde “map” es una función que traduce la fase en un ángulo dentro del intervalor [].

Esta última función de detección, según resultados mostrados en [1], funciona exitosamente para señales de audio armónico, pero no funciona para señales de percusión (inarmónicas).

## Detección de Picos

Una vez hallada la función de detección o novedad, se proceden a identificar los picos de esta, teniendo en cuenta los picos lo suficientemente pronunciados y que superen un “threshold” (umbral) fijo. Una opción más eficaz es implementar una función que genere un umbral adaptativo, es decir que tome un valor de umbral para cada muestra de la función de detección, basándose en muestras del entorno para hallar este umbral óptimo. Estos algoritmos se pueden implementar computacionalmente con librerías nativas de algunos lenguajes de programación como lo son “Python” o “JavaScript”.

## Offset

Como se ha mencionado en la sección B, la detección de onset puede realizarse de manera relativamente sencilla una vez que se ha detectado el onset, comparando la función original con un umbral que se corresponda con el ruido ambiental y así decidir el instante para el cual se da la nota musical por finalizada (instante de detección de offset). En efecto para obtener los resultados que se mostrarán más adelante, se utilizó un umbral de offset teniendo en cuenta que ante una señal sonora normalmente existe un ruido ambiental que se corresponde en -80dB.

Debido a que podría ocurrir que se aplique el algoritmo de segmentación en una señal de audio que presente una cantidad numerosa de notas (esto es lo que sucede en la mayoría de los casos para el cual este algoritmo es de interés), luego podría existir un nuevo onset antes de la detección del offset correspondiente el anterior onset. Ante este caso, se decidió determinar el offset mediante el nuevo onset., es decir que el evento de offset y el nuevo onset coinciden para este caso. Esto quiere decir que la finalización de la nota la determina el comienzo de la siguiente nota, siempre que esta última se manifieste lo suficientemente rápido tal que no se detecte offset para la nota anterior.

## Implementación y Resultados de la Segmentación

Para realizar la segmentación se ha utilizado el algoritmo de HFC para obtener la función de detección y a esta se la proceso aplicando una decimación de orden 4 para luego realizar una interpolación del mismo orden, logrando así suavizar la función de detección y evitar que se detecten picos que no correspondan a onsets.

Una vez realizado esto, se detectaron los picos y se utilizaron estos mismos para obtener los offsets.

Esta segmentación se ha aplicado a una señal de audio con cuatro notas y se obtuvieron los resultados de la Fig. (¿?).

En dicha figura, se pueden observar los onsets detectados como cruces ‘x’ y los offsets como círculos ‘o’.

ACA VA LA FIGURAAAAAAAAAAA

# MATH

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# Units

Use either SI (MKS) or CGS as primary units. (SI units are strongly encouraged.) English units may be used as secondary units (in parentheses). **This applies to papers in data storage.** For example, write “15 Gb/cm2 (100 Gb/in2).” An exception is when English units are used as identifiers in trade, such as “3½-in disk drive.” Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.

The SI unit for magnetic field strength *H* is A/m. However, if you wish to use units of T, either refer to magnetic flux density *B* or magnetic field strength symbolized as µ0*H*. Use the center dot to separate compound units, e.g., “A·m2.”

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Because IEEE will do the final formatting of your paper, you do not need to position figures and tables at the top and bottom of each column. In fact, all figures, figure captions, and tables can be at the end of the paper. Large figures and tables may span both columns. Place figure captions below the figures; place table titles above the tables. If your figure has two parts, include the labels “(a)” and “(b)” as part of the artwork. Please verify that the figures and tables you mention in the text actually exist. **Please do not include captions as part of the figures. Do not put captions in “text boxes” linked to the figures. Do not put borders around the outside of your figures.** Use the abbreviation “Fig.” even at the beginning of a sentence. Do not abbreviate “Table.” Tables are numbered with Roman numerals.

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Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity “Magnetization,” or “Magnetization *M*,” not just “*M*.” Put units in parentheses. Do not label axes only with units. As in Fig. 1, for example, write “Magnetization (A/m)” or “Magnetization (Am−1),” not just “A/m.” Do not label axes with a ratio of quantities and units. For example, write “Temperature (K),” not “Temperature/K.”

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## References

Number citations consecutively in square brackets [1]. The sentence punctuation follows the brackets [2]. Multiple references [2], [3] are each numbered with separate brackets [1]–[3]. When citing a section in a book, please give the relevant page numbers [2]. In sentences, refer simply to the reference number, as in [3]. Do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] shows ... .” Please do not use automatic endnotes in *Word*, rather, type the reference list at the end of the paper using the “References” style.

Number footnotes separately in superscripts (Insert | Footnote).[[2]](#footnote-2) Place the actual footnote at the bottom of the column in which it is cited; do not put footnotes in the reference list (endnotes). Use letters for table footnotes (see Table I).

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Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First use the equation editor to create the equation. Then select the “Equation” markup style. Press the tab key and write the equation number in parentheses. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

 (1)

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but T is the unit tesla). Refer to “(1),” not “Eq. (1)” or “equation (1),” except at the beginning of a sentence: “Equation (1) is ... .”

## Other Recommendations

Use one space after periods and colons. Hyphenate complex modifiers: “zero-field-cooled magnetization.” Avoid dangling participles, such as, “Using (1), the potential was calculated.” [It is not clear who or what used (1).] Write instead, “The potential was calculated by using (1),” or “Using (1), we calculated the potential.”

Use a zero before decimal points: “0.25,” not “.25.” Use “cm3,” not “cc.” Indicate sample dimensions as “0.1 cm × 0.2 cm,” not “0.1 × 0.2 cm2.” The abbreviation for “seconds” is “s,” not “sec.” Do not mix complete spellings and abbreviations of units: use “Wb/m2” or “webers per square meter,” not “webers/m2.” When expressing a range of values, write “7 to 9” or “7-9,” not “7~9.”

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) In American English, periods and commas are within quotation marks, like “this period.” Other punctuation is “outside”! Avoid contractions; for example, write “do not” instead of “don’t.” The serial comma is preferred: “A, B, and C” instead of “A, B and C.”

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# Some Common Mistakes

The word “data” is plural, not singular. The subscript for the permeability of vacuum µ0 is zero, not a lowercase letter “o.” The term for residual magnetization is “remanence”; the adjective is “remanent”; do not write “remnance” or “remnant.” Use the word “micrometer” instead of “micron.” A graph within a graph is an “inset,” not an “insert.” The word “alternatively” is preferred to the word “alternately” (unless you really mean something that alternates). Use the word “whereas” instead of “while” (unless you are referring to simultaneous events). Do not use the word “essentially” to mean “approximately” or “effectively.” Do not use the word “issue” as a euphemism for “problem.” When compositions are not specified, separate chemical symbols by en-dashes; for example, “NiMn” indicates the intermetallic compound Ni0.5Mn0.5 whereas “Ni–Mn” indicates an alloy of some composition NixMn1-x.

Be aware of the different meanings of the homophones “affect” (usually a verb) and “effect” (usually a noun), “complement” and “compliment,” “discreet” and “discrete,” “principal” (e.g., “principal investigator”) and “principle” (e.g., “principle of measurement”). Do not confuse “imply” and “infer.”

Prefixes such as “non,” “sub,” “micro,” “multi,” and “ultra” are not independent words; they should be joined to the words they modify, usually without a hyphen. There is no period after the “et” in the Latin abbreviation “*et al.*” (it is also italicized). The abbreviation “i.e.,” means “that is,” and the abbreviation “e.g.,” means “for example” (these abbreviations are not italicized).

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Authors should consider the following points:

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5. Papers that describe ongoing work or announce the latest technical achievement, which are suitable for presentation at a professional conference, may not be appropriate for publication in a TRANSACTIONS or JOURNAL.

# Conclusion

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

Appendix

Appendixes, if needed, appear before the acknowledgment.

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The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ... .” **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.**

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   T. C. Author is with the Electrical Engineering Department, University of Colorado, Boulder, CO 80309 USA, on leave from the National Research Institute for Metals, Tsukuba, Japan (e-mail: author@nrim.go.jp). [↑](#footnote-ref-1)
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