"Effect of Carnatic and Hindustani Musical Therapy (MT) on Hypertension patients with Chronic Kidney Disease (CKD) and Rheumatoid Arthritis patients"

Ph.D. Thesis

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For the award of

DOCTOR OF PHILOSOPHY

IN

MEDICAL BIOPHYSICS

BY

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Reg.No.002

Guided by

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(Research Director and PhD Guide)

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CERTIFICATE

This is to certify that Mrs. Netravathi N has registered on 1.04.2013 with Registration Number 002, through Indian Holistic Medical Academy for Doctor of Philosophy in Medical Biophysics from The International Open University for Complementary Medicines, Colombo. He has worked on a cancer research titled **"Effect of Carnatic and Hindustani Musical Therapy (MT) on Hypertension patients with Chronic Kidney Disease (CKD) and Rheumatoid Arthritis patients"** under my supervision and he has attended 3 International Symposia's and presented 3 research papers in and this research paper is under review in the Journal of Clinical Investigation since April 2013 to till date. She has successfully completed the research work with outstanding results.

Prof. Dr. Geetha Viswanathan
Research Director and PhD Guide
Indian Holistic Medical Academy (IHMA)

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NETRAVATHI N

DECLARATION

I, Netravathi N, have carried out my research thesis titled **“Effect of Carnatic and Hindustani Musical Therapy (MT) on Hypertension patients with Chronic Kidney Disease (CKD) and Rheumatoid Arthritis patients”** under the guidance and supervision of Prof. Dr. Geetha Viswanathan, Research Director and PhD Guide, IHMA and this work has not been submitted elsewhere for any other Degree, Diploma, Associateship, Fellowship or other similar titles.

Nethravathi N
Date: November 2014
Place: Bangalore

SYNOPSIS

"Effect of Carnatic and Hindustani Musical Therapy (MT) on Hypertension patients with Chronic Kidney Disease (CKD) and Rheumatoid Arthritis patients"

Modern management of Chronic Kidney Disease (CKD) and Rheumatoid Arthritis (RA) as well as efforts to obtain better symptom control are directed toward recovering the patient's functional status, thus improving both clinical disability and quality of life. To achieve global improvement in personal well-being, drugs, in accordance with standard guidelines, as well as interdisciplinary measures, such as physical exercise, occupational and speech therapy, and psychological, nutritional, and social counseling, have been used. We explored Musical Therapy (MT) as a method for inclusion in CKD rehabilitation programs. Even though MT is widely used in a variety of settings, including hospitals hospitals, rehabilitation centers, special schools, and hospices the literature contains few assessments of MT in medical care. Music has been used as a form of therapy for many different diseases and, unless hearing is totally affected, may indeed be experienced and appreciated by even the most severely physically or cognitively impaired subjects.

MT reduces anxiety in patients undergoing cardiac procedures throughout the perioperative period and in those who have had a myocardial infarction moreover, music seems to relax patients undergoing dialysis or invasive diagnostic procedures. It has also been suggested that music may modify release of stress hormones and cardiac function as well as the respiratory pattern.

Hypertension in CKD patients is a common clinical disease and a major risk to human health. Many clinical findings indicate that certain types of music can reduce blood pressure (BP), and music therapy (MT) is considered as an important part of anti-hypertension treatment. We integrate our former related research achievement into the Classical Music Therapy.

Finally, anecdotal evidence and clinical studies show that MT improves in controlling BP functions and quality of life of patients with CKD and RA patients.

The first aim of this study was to verify the efficacy of MT on patients with CKD & RA. Moreover, given that PT is the main nonpharmacologic course of intervention in CKD, we conducted a randomized, controlled, single-blinded, prospective study with MT. In addition to measuring clinical changes, we evaluated the influence of these therapy on both the emotional wellbeing and quality of life of CKD patients.

The following methodology has been involved in this study

- Analysis of Waveform, Intensity, Spectrogram, Pitch and Duration of all the 9 Musical Tracks
- Clinical Study on CKD & RA patients

ABSTRACT

Modern management of Chronic Kidney Disease (CKD) and Rheumatoid Arthritis (RA) as well as efforts to obtain better symptom control are directed toward recovering the patient's functional status, thus improving both clinical disability and quality of life. To achieve global improvement in personal well-being, drugs, in accordance with standard guidelines, as well as interdisciplinary measures, such as physical exercise, occupational and speech therapy, and psychological, nutritional, and social counseling, have been used. We explored Classical Musical Therapy (MT) using 9 musical tracks as a method for inclusion in CKD rehabilitation programs. Even though MT is widely used in a variety of settings, including hospitals hospitals, rehabilitation centers, special schools, and hospices the literature contains few assessments of MT in medical care. Music has been used as a form of therapy for many different diseases and, unless hearing is totally affected, may indeed be experienced and appreciated by even the most severely physically or cognitively impaired subjects.

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clinical changes, we evaluated the influence of these therapies on both the emotional wellbeing and quality of life of CKD patients.

CONTENTS

ABBREVIATIONS

ACR: Albumin: Creatinine Ratio

ACE: Angiotensin Converting Enzyme

ARB's: Angiotensin II Receptor Blokers

AER: Albumin Excretion Rate

BMI: Body Mass Index

BP: Blood Pressure

CT: Computed Tomography

CKD: Chronic Kidney Disease

Da: Dhaivatha

dB: Decibel

ERB: Equivalent Rectangular Bandwidth

ESRD: End Stage Renal Disease

f: Frequency

FFT: Fast Fourier Transformation

Ga: Ghandhara

GDG: Guideline Development Group

GFR: Glomerular Filtration Rate

GMM: Mixture of Gaussians

Hg: Hemoglobin

Hz: Hertz

IgA: Immunoglobulin A

LPC: Linear Prediction Coefficients

Ma: Madhyama

MKL: Multiple Kernel Learning

MRFIT:

MRI: Magnetic Resonance Imaging

MT: Music Therapy

Ni: Nishada

NMF: Non-Negative Matrix Factorization

Pa: Panchama

PCR: Protein: Creatinine Ratio

RA: Rheumatoid Arthritis

Ri: Rishabha

Sa: Shadya

SMD: Speech/Music Discrimination

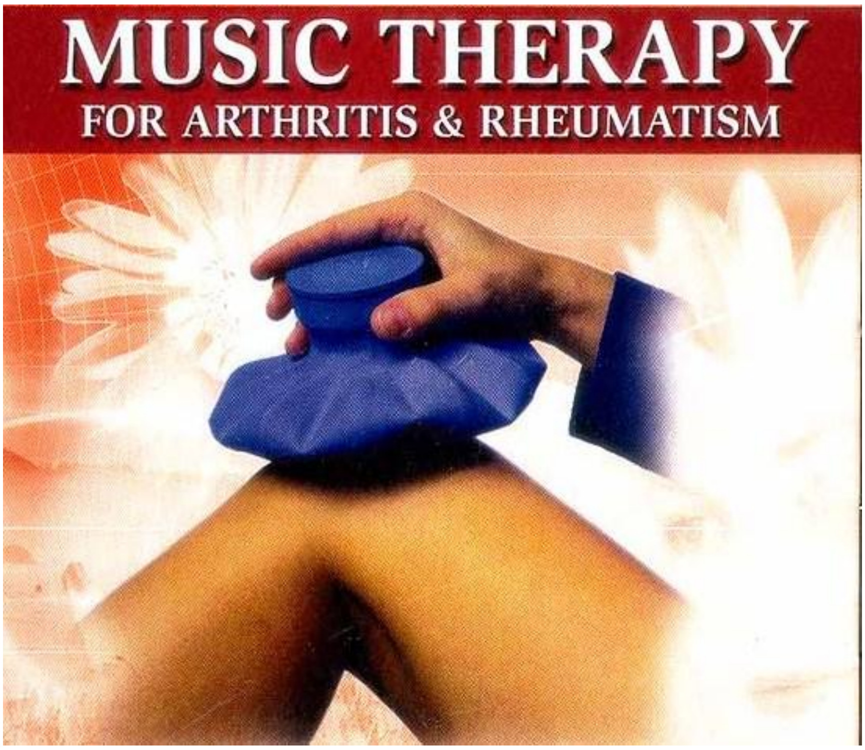
STFT: Short time Fourier Transformation

SVG: Scalable Vector Graphics

TNF-α: Tumor Necrosis Factor alpha

UTI: Urinary Tract Infection

INTRODUCTION



INTRODUCTION

Music Theory

Fig.1: Sangeetha Pithamaha of Carnatic Classical Music: Sri Purandara Dasa

Technical Terms

Sangeetham is an Indian term for Music. A group of musical sounds, which are called swaras that give melody and pleasant feelings to the ears, is called Sangeetham. Ancient writers hold the view that vocal music, instrumental music and dance together constituted sangeetham. Later, dance was separated from the first two.

Shruthi is an audible sound which can be heard distinctly. It is a musical sound which a well trained human ear is capable of distinguishing. It is the Key note or Adhara Shadjam, based on which all other Swaras are derived.

Swara is a musical note which is pleasing to the ears. There are seven basic Swaras invented by Sri Purandara Dasa, known as **Saptha Swaras**. They are -

1. Shadjam (shortly - Sa)
2. Rishabham (Ri)
3. Ghandaram (Ga)
4. Madhyamam (Ma)
5. Panchamam (Pa)
6. Dhaivatham (Dha)
7. Nishadham (Ni)

Dwadasa Swarasthanas

Out of the seven swaras, Shadjam (Sa) and Panchamam (Pa) are constant. They are called Achala Swaras. The remaining five swaras admit varieties and they are called Chala Swaras. rn combination, both Achala and Chala swaras yield 12 different musical notes and they are called Dwadhasa Swarasthanas.

The Dwadasa Swarasthanas are

1. Shadjam......................................Sa
2. Suddha Rishabam.......................Su Ri
3. Chatusruthi Rishabam.................Cha Ri
4. Sadharana Gandharam...............Sa Ga
5. Anthara Ghandaram...................An Ga
6. Suddha Madhyamam..................Su Ma
7. Prathi Madhyamam.....................Pra Ma
8. Panchamam................................Pa
9. Suddha Dhaivatham...................Su Dha
10. Chatusruthi Dhaivatham.............Cha Dha
11. Kaisiki Nishadham......................Kai Ni
12. Kakali Nishadham.......................Ka Ni_2

Arohana – Series of Swaras in the ascending order of pitch.

Avarohana – Series of swaras in the descending order of pitch.

Moorchana – Arohana and Avarohana together, is called Moorchana

Sthayi – A series of swaras, beginning with Sa and ending with Ni, is called Sthayi.

There are Five Sthayis.

1. Anumandra Sthayi
2. Mandra Sthayi
3. Madhya Sthayi
4. Tara Sthayi
5. Ati-Tara Sthayi

The Sthayi in which we normally sing is the madhya sthayi. The swaras following the upper Shadjam of madhya shtayi are in Tara Sthayi, and the swaras following upper shadjam of tara sthayi are in Ati-Tara Stayi. The Sthayi preceding Madhya stayi is the Madhra sthayi, and the swaras preceding the Mandhra Stayi Shadjam are in Anumandra stayi.

Purvanga – The group of first four swaras of the Saptha Swaras – Sa, Ri, Ga, Ma – is known as the Purvanga.

Uttharanga – The group of last three notes – Pa Dha Ni – is known as Uttharanga.

Dhathu – The swara part of the musical composition is known as Dhathu.

Mathu – The sahitya part of a musical composition is known as Mathu.

Akshara Kala – Unit time in music is called Akshara Kala.

Thrikaala – Kala is refers to the speed of the musical piece. There are Three Kalas,

1. *Prathama Kala* – First degree of speed. One note is sung in one Akshara Kala.
2. *Dwitiya Kala* – Second degree of speed, twice faster than Prathama kala. Two notes are sung in one Akshara Kala.
3. *Tritiya Kala* – Third degree of speed, twice faster than Dwitiya Kala. Four notes are sung in one Akshara Kala.

Thourya Trikam - Vocal Music, Instrumental Music and Dance, all the three combined together is referred to as Thouryathrikam.

Tala – Musical time or measure.

Avartha – It is the completion of a tala angas or time measure.

Angas, Shadangas – In order to facilitate easy and accurate method of reckoning musical time, six angas have been devised. They are known as Shadangas or six angas.

Fig.2: Trimurtis of Carnatic Music

The music of the geetha is simple melodic extension of the raga in which it is composed. Its tempo is uniform. It is a continuous composition without the sections pallavi, anupallavi and charanam. The geetha is sung without repetition from the beginning to end. Some geethas have two sections (Khandikas) and some have three. Some geethas are concluded by repeating a portion of the opening part.

Geethas are learnt after a course in the preliminary swara exercises and alankaras. There are geethas in all the sapta talas and their varieties. Geethas are of two kinds. They are -

1. Samanya geetha (Sanchari / Sadharana / Lakshya geetha)
2. Lakshana geetha

Samanya Geethas (Sanchari Geethas) are usually in praise of God, Musical luminaries and Acharyas. Ex: The *Sapta Tala Geetha* in *Nata Raga* "*Gana Vidya Durandara*" in praise of Venkata Subbayya by Pydala Gurumurthy Sastry. Geethas are set in medium tempo. There are no sangatis or variations and the flow of music is natural. Neither intricate combinations nor terse sancharis are found in its music. The swarupa is well brought out in each case. For each note of the Dhathu there is usually a syllable in the Sahitya. Sometimes meaningless phrases are found interspersed in it. There are called

Matrika Padas or Geethalankara phrases. Ex: *aa yiya yiya* in *Arabi* Geetham "*Rere Sri Rama*". These phrases lend a characteristic beauty to the sahitya of geethas. They are introduced for onramentation only. These syllables remind one of similar syllables occuring in samaganam. There are instances of famous Sanskrit slokas which have been cleverly introduced as sahityas for sanchari 5 geethas. The geetha in Bhairavi Raga *"Sri Ramachandra"* and the geetha in Nata Raga *"Amari Kimari"* are well known examples.

In a geetha the number of swaras present in an avartha is equal to the number of aksharas forming the avartha. The deerga swara being rekoned as two swaras will have two aksharas in the sahitya or a deerga three also this being so, a geetha in Chaturasra Jaati Dhruva Tala should not be taken as Tisra Jaati Triputa Tala considering two swaras for each count. Likewise a geetha in Chaturasra Jaati Rupaka Tala should not be taken as Tisra Jaati Eka Tala with two swaras for each count and so on. This will not be in keeping with the rhythmical construction of the composition. Geethas are compositions in Ati Chitra Tama Marga. They are in Ekakshara Kalam (One Swara for each count). Purandara Dasa's introductory geethas in praise of Vigneswara, Maheswara and Vishnu are sometimes referred to as Pillari Geethas. The significant introduction of vowels in the very first geetha is noteworthy and justifies the genius of the composer. *Pydala Gurumurthy Sastry* was a prolific composer of geethas after Purandara Dasa. He is referred to as *'Veyyi Geethala' Pydala Gurumurthy Sastry*. After him no noteworthy composer has attempted to compose Sanchari Geethas.

Ganakrama – Order of Singing a Geetha

Geethas are sung from the beginning to the end without repeating the avarthas. If a geetha consists of two sections (Kandikas) as in Kalyani *"Kamala Jaadala"*, the second section is sung after the first. There are different categories of Sadharana Geetha

1. **Pillari Geetha:** Geethas written in praise of God like Vigneswara, Mahesara, Mahavishnu etc are called Pillari Geetha. Ex: Sri Gananadha in Malahari Ragam, Rupaka Thalam.

2. **Gana Raga Geetha:** Geethas written in Gana Ragas like Nata, Gowla, Arabi, Sri Ragam, Varaali are called Gana Raga Geethas. Ex: Re Re Sri Rama in Arabi Ragam, Triputa Thalam

3. **Rakthi Raga Geetha**: Geethas set to Rakthi ragas like Mohana and Kalyani are called Rakthi Raga Geethas. Ex: Vara Veena in Mohana Ragam. Rupaka Thalam.

4. **Raga Malika Geetha**: In a same geetha, if more than one raga is used, it's called Raga Malika Geetha. This type of Geethas are not in use today. Notable composers who wrote Geethas:

- Purandara Dasa
- Paidala Gurumurthy Sastry
- Govindhacharya
- Venkata Makhi
- Rama Mathya

Lakshna Geetha

In a Lakshana Geetha, Sahityam will describe the lakshna of the Raga in which the Geetha is set to. There will be a small Deiva Stuthi too. Lakshna Geethas describe the following lakshanas of the ragas: 6

1. Melam/Janyam: Is the Ragam a Mela Kartha ragam or a derivative ragam (Janya Ragam) based on a Melam.
2. Bashanga or Ubhanga Ragam
3. Whether the raga is Audava, Shadava or Sampoorna Raga.
4. Arohana and Avarohana of the Ragam
5. Vakram/Varjam – If there's any vakram or varjam in Arohana/Avarohana of the Ragam
6. Jiva, Nyasa (Ending Note) and Graha (Starting) swaras of the raga.
   In many ragas Lakshna geethas are available.

Swara Pallavi or Jathi Swaram

A *Swara Pallavi* (also known as *Jathi Swaram*) is a kind of composition which has only the Dhathu part (Swaras) with no Sahitya. There are learnt after learning Geethas and before Varanas. These are scholarly compositions and their Dhathu has the Raga Bhavam. Usually Swara Pallavis are set to Madhyama Kalam (Medium Tempo) and set to Adhi or Chaapu Thalas. Swara pallavis can have 2 or 3 parts in the following manner:

1. Pallavi – Anu pallavi – Charanam
2. Pallavi – Charanam

In some charanams Mrudanga Jatis are heard, hence the name “Jathi Swaram”.

Swara pallavis usually have 4 to 8 charanams. Compositional structure of a Swara Pallavi is same as that of Swara jati. The only difference is, a Swarajati has the Maathu part (Sahityam) too where Swara Pallavi lacks the Sahitya part.

Ganakrama (Order of Singing) of a Swara Pallavi

First Pallavi is sung. Then Charanas are sung. At the end of each Charanam, pallavi is sung again. So the order of singing is like this

Pallavi

Charanam 1 – Pallavi

Charanam 2 – Pallavi

etc.

Notable composers who wrote Swara Pallavis include

- Srimaan. Sri. Ramacharyulu
- Swathi Thirunaal
- Ponnaiah Pillai[1]

CHRONIC KIDNEY DISEASE (CKD)

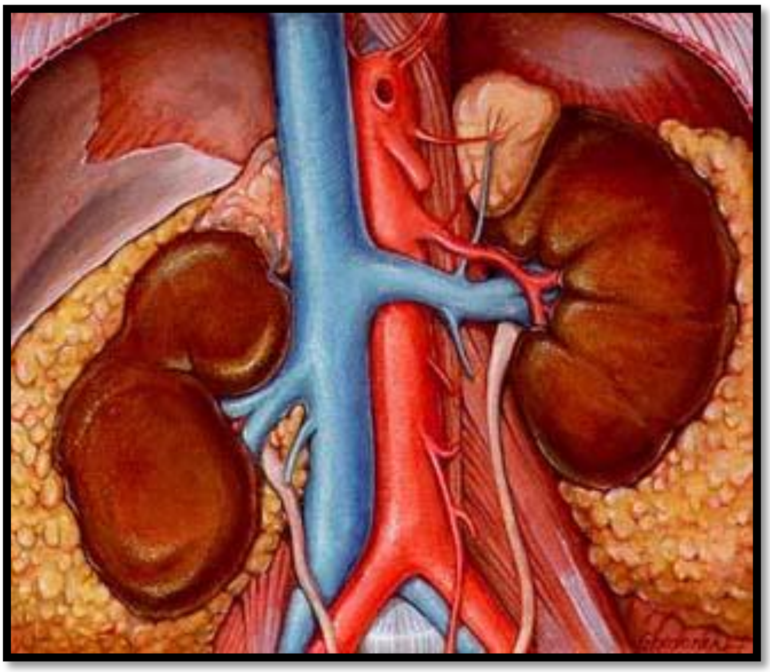


Fig.3: Schematic representation of Kidneys

Chronic kidney disease (CKD) describes abnormal kidney function and/or structure. It is common, frequently unrecognised and often exists together with other conditions (for example, cardiovascular disease and diabetes). When advanced, it also carries a higher risk of mortality. The risk of developing CKD increases with increasing age, and some conditions that coexist with CKD become more severe as kidney dysfunction advances. CKD can progress to established renal failure in a small but significant percentage of people.

CKD is usually asymptomatic. But it is detectable, and tests for detecting CKD are both simple and freely available. There is evidence that treatment can prevent or delay the progression of CKD, reduce or prevent the development of complications and reduce the risk of cardiovascular disease. However, because of a lack of specific symptoms people with CKD are often not diagnosed, or diagnosed late when CKD is at an advanced stage.

The ‘National service framework for renal services’ adopted the US ‘National Kidney Foundation kidney disease outcomes quality initiative’ (NKF-KDOQI) classification of CKD. This classification divides CKD into five stages. Stages 3–5 may be defined by glomerular filtration rate (GFR) alone, whereas stages 1 and 2 also require the presence of persistent proteinuria, albuminuria or haematuria, or structural abnormalities.

On average 30% of people with advanced kidney disease are referred late to nephrology services from both primary and secondary care, causing increased mortality and morbidity. Over 2% of the total NHS budget is spent on renal replacement therapy (dialysis and transplantation) for those with established renal failure.

Strategies aimed at earlier identification and (where possible) prevention of progression to established renal failure are therefore clearly needed. This clinical guideline seeks to address these issues by providing guidance on identifying:

- People who have or are at risk of developing CKD
- Those who need intervention to minimise cardiovascular risk and what that intervention should be
- Those who will develop progressive kidney disease and/or complications of kidney disease and how they can be managed
- Those who need referral for specialist kidney care.

Key priorities for implementation

- To detect and identify proteinuria, use urine albumin:creatinine ratio (ACR) in preference, as it has greater sensitivity than protein:creatinine ratio (PCR) for low levels of proteinuria. For quantification and monitoring of proteinuria, PCR can be used as an alternative. ACR is the recommended method for people with diabetes.

- Offer angiotensin-converting enzyme inhibitors (ACE inhibitors) / angiotensin-II receptor blockers (ARBs) to non-diabetic people with CKD and hypertension and ACR 30 mg/mmol or more (approximately equivalent to PCR 50 mg/mmol or more, or urinary protein excretion 0.5 g/24 h or more).

- Stage 3 CKD should be split into two subcategories defined by:

− GFR 45–59 ml/min/1.73 m^2 (stage 3A)

− GFR 30–44 ml/min/1.73 m^2 (stage 3B)

Table.1

Stages of chronic kidney disease (updated) Stage	GFR (ml/min/1.73 m^2)	Description
1	≥ 90	Normal or increased GFR, with other evidence of kidney damage
2	60–89	Slight decrease in GFR, with other evidence of kidney damage
3A	45–59	Moderate decrease in GFR, with or without other evidence of kidney damage
3B	30–44	
4	15–29	Severe decrease in GFR, with or without other evidence of kidney damage
5	< 15	Established renal failure

[a] Use the suffix (p) to denote the presence of proteinuria when staging CKD (recommendation 1.2.1).

Risk factors, diagnosis and classification

All patients with evidence of persisting kidney damage, ie for >90 days, are defined as having CKD. Kidney damage refers to any renal pathology that has the potential to cause a reduction in renal functional capacity. This is most usually associated with a reduction in glomerular filtration rate (GFR) but other important functions may be lost without this occurring.

Detection of individuals at higher risk of developing chronic kidney disease

Epidemiology reveals an association between a number of clinical characteristics and the development of chronic kidney disease. For many potential risk factors, the supporting evidence is inconclusive, of poor methodological quality or does not clearly establish a causal relationship. Decisions regarding risk factor modification should be taken on an individual basis.

Factors which may be complicated by renal disease, but are not risk factors for its development, such as lithium toxicity or lupus nephritis are not considered here[2].

DIABETES MELLITUS

Diabetic nephropathy is a renal complication of diabetes mellitus. Diabetes is the commonest cause of ESRD requiring renal replacement therapy. The age-adjusted incidence of all-cause ESRD in men with diabetes is more than 12 times greater than in men without diabetes (199.0 *vs* 13.7 cases per 100,000 person years; relative risk (RR) 12.7; 95% confidence interval (CI), 10.5 to 15.4). This increased incidence was attributable to both diabetic and non-diabetic nephropathy. In 2005, 0.5% of the population with diabetes who were recorded in the National Diabetes Survey were reported to be at ESRD. The linkage of diabetes with earlier stages of CKD is more difficult to demonstrate. In one cross sectional study diabetes was found to be associated with CKD with the relative risk increasing with the severity of CKD.2 In the baseline cohort analysis of a large Medicare American study (n=1,091,201 aged >65 years) the presence of diabetes was found to double the risk of developing CKD compared with those without diabetes (odds ratio (OR) 2.04; 95% CI 2.00 to 2.09, p<0.0001). When followed up over two years, people from this cohort with diabetes, but without known CKD, developed kidney damage at a rate of 0.2 per 100 patient years as compared with 0.04 per 100 patient years for people without diabetes. The progression of disease was also more frequent in patients with CKD and diabetes with 3.4 per 100 patient years requiring dialysis as compared with CKD patients without diabetes who reached this end point at less than half the rate (1.6 per 100 patient years; p<0.0001). In a community based longitudinal cohort study of patients from the Framingham Offspring Study 2,585 individuals without evidence of CKD were monitored over 12 years. In multivariate analysis those with diabetes at baseline had an increased rate of development of CKD (OR 2.60; 95% CI 1.44 to 4.70) over a 12 year period.

Within the limitations of cross-sectional cohort methodology and longitudinal cohort data, diabetes is a significant risk factor for CKD and individuals with both diabetes and CKD appear to be more likely to progress to end-stage renal disease. This supports current recommendations in national guidelines on the surveillance of patients with diabetes for CKD. The optimal surveillance strategy has not been defined.

HYPERTENSION

Fig.4: Palpitation of Systolic and Diastolic BP sounds

Four studies have shown that hypertension is a risk factor for CKD.2,13,14,17 These were large, retrospective studies with high attrition rates and hence subject to potential selection bias. In a fifth small study (33 patients with hypertension, 30 without hypertension) the demonstrated association between hypertension and CKD did not reach statistical significance. SIGN guideline 97 on risk estimation and the prevention of cardiovascular disease suggests that cardiovascular risk factors (including a measure of renal function) should be monitored at least annually in individuals who are on antihypertensive or lipid lowering therapy.

Patients who are on antihypertensive or lipid lowering therapy should have renal function assessed at least annually.

SMOKING

A good quality Swedish case control study provides supportive evidence for current or former history of smoking (at five years before survey) as a significant risk factor for CKD in a community based population. Odds ratios increased with increasing frequency and duration of smoking.

A ‘pack year’ is calculated by multiplying the number of packs of cigarettes smoked per day by the number of years an individual has smoked. More than 15 pack years of smoking increased the risk of CKD significantly (16-30 pack years: OR 1.32; >30 pack years: OR 1.52).

Smoking should be considered as a risk factor for the development of chronic kidney disease.

CARDIOVASCULAR DISEASE

One cross-sectional study on an American Medicare population (aged >65 years) was identified. Patients with atherosclerotic vascular disease were 1.5 times more likely to develop CKD than those without, and patients with congestive cardiac failure were nearly twice as likely to do so. The Medicare population was selective in excluding, for example, certain patients with health insurance. There were also problems of definition and coding since classification was based on diagnostic coding at billing which does not distinguish between CKD stages.

AGE

Two retrospective studies, were consistent in showing that age was a significant risk factor; the first examined <65 year olds compared to >65 year olds with a resultant odds ratio of 101.5 (95% CI, 61.4 to 162.9) indicating increased risk of renal impairment at an older age. The second showed increasing relative risks in a population>65 years old, albeit with overlapping confidence intervals.

The Framingham Offspring study established a graded risk associated with age (OR of 2.36 per 10 year age increment; 95% CI 2.00 to 2.78). There is uncertainty as to whether age associated decline in GFR is pathological and should be afforded the same significance as declining function in other situations.

CHRONIC USE OF NON-STEROIDAL ANTI-INFLAMMATORY DRUGS

Two retrospective single cohort studies of physicians 22 and nurses 23 examined non-steroidal anti-inflammatory drug (NSAID) use as a risk factor for developing CKD. Neither found chronic use of aspirin or NSAIDs in prescribed doses to be significant risk factors over a period of 14 and 11 years respectively, although one found use of paracetamol to be so. Selection bias was a significant limitation in both studies, since subjects were not representative of the general population, and small proportions of the original sample populations were included in the final analyses.

OBESITY AND SOCIOECONOMIC STATUS

One cross-sectional Dutch study on obesity as a risk factor for CKD concluded that BMI (body mass index) had no effect on the prevalence of CKD, although some evidence was presented for a central pattern of fat distribution being associated with CKD compared with a peripheral pattern. This retrospectively obtained evidence had limitations, including low response rate.

An American cohort study concluded that white men and African-American women living in an area of low socioeconomic status had a greater risk of CKD progression than white men and African-American women living in a higher designated area. No similar CKD risk progression was found for white women and African-American men. There were methodological limitations in this study and little information on sampling and attrition rates was available.

A Swedish, community based case control study showed that lower household and individual level socioeconomic status and fewer years of education were significant risk factors for CKD in the Swedish population.

Low socioeconomic status should be considered as a risk factor for the developmentof chronic kidney disease.

Detecting kidney damage

Kidney damage may be detected either directly or indirectly. Direct evidence may be found on imaging or on histopathological examination of a renal biopsy. A range of imaging modalities including ultrasound, Computed Tomography (CT), magnetic resonance imaging (MRI) and isotope scanning can detect a number of structural abnormalities including polycystic kidney disease, reflux nephropathy, chronic pyelonephritis and renovascular disease.

Renal biopsy histopathology is most useful in defining underlying glomerular disease such as immunoglobulin A (IgA) nephropathy or focal glomerulosclerosis. Indirect evidence for kidney damage may be inferred from urinalysis. Glomerular inflammation or abnormal function can lead to leakage of red blood cells or protein into the urine which in turn may be detected as proteinuria or haematuria. Urinary abnormalities may have alternative causes unrelated to kidney dysfunction and there are methodological issues associated with their measurement.

Proteinuria

Proteinuria is associated with cardiovascular and renal disease and is a predictor of end organ damage in patients with hypertension. Detection of an increase in protein excretion is known to have both diagnostic and prognostic value in the initial detection and confirmation of renal disease.

In evaluating the diagnostic accuracy of tests of proteinuria, measurement of protein (or albumin) excretion in a timed urine collection over 24 hours has been used as a reference standard. The relationship between urinary protein (and albumin) concentrations expressed as a ratio to creatinine and other common expressions of their concentration.

Urine dipstick testing

Although urine dipstick testing is widely available, convenient and relatively cheap, evidence for its diagnostic accuracy is limited to studies that have compared dipstick testing with either protein or albumin excretion in a timed urine collection over 24 hours. 29-36 Pooling the six obstetric studies 29-34 gives a positive likelihood ratio of 3.48 (95% CI 1.66 to 7.27) and a negative likelihood ratio of 0.6 (95% CI 0.45 to 0.8) for predicting 300 mg/24-hour proteinuria at 1+ or more (likelihood ratios of >5 or <0.2 provide good evidence of the diagnostic performance of tests in rule-in and rule-out modes respectively). The accuracy of automated analysis is greater than visual analysis of urine dipsticks. In one study, the positive likelihood ratio was 4.27 (95% CI 2.78 to 6.56) and negative likelihood ratio 0.22 (95% CI 0.14 to 0.36) for automated urinalysis compared with 2.27 (95% CI 1.47 to 3.51) and 0.64 (95% CI 0.49 to 0.82) for visual urinalysis.

2 Risk factors, diagnosis and classification Diagnosis and management of chronic kidney disease

The existing limited evidence base does not indicate that dipstick testing can reliably be used to diagnose the presence or absence of proteinuria. Automated urinalysis warrants further evaluation. There is evidence from the Multiple Risk Factor Intervention Trial (MRFIT), that dipstick proteinuria in men predicts long term risk of ESRD. In the MRFIT cohort the hazard ratio for ESRD over 25 years for patients with ≥1+ dipstick proteinuria (3.1, 95% CI 1.8 to 5.4) was higher than for an estimated GFR of <60 ml/min/1.73 m2 (2.4, 95% CI 1.5 to 3.8). In addition, dipstick proteinuria identifies individuals at higher cardiovascular risk. A systematic review of the practice of excluding urinary tract infection (UTI) in patients with proteinuria found that symptomatic, but not asymptomatic UTI is commonly associated with proteinuria/albuminuria. A threshold above which proteinuria can be definitively attributed to intrinsic renal disease as opposed to a superimposed UTI could not be identified.

Protein/creatinine ratio

A systematic review comparing measurement of protein/creatinine ratio (PCR) on a random urine sample with 24-hour protein excretion included studies carried out during pregnancy and studies performed in renal and rheumatology outpatient clinics.27 Likelihood ratios <0.2 were reported in most of the studies, supporting the diagnostic performance of PCR as a test of exclusion. There was a high prevalence of proteinuria in the populations studied, and these findings should be extrapolated with caution to populations with a lower prevalence.

Protein/creatinine ratio measured in early morning or random urine samples is at least as good as 24-hour urine protein estimation at predicting the rate of loss of GFR in patients with CKD who do not have diabetes.

Albumin/creatinine ratio

A meta-analysis of ten studies in patients with diabetes compared a random albumin/creatinine ratio (ACR) measurement with albumin excretion rate (AER) from overnight or 24-hour timed samples. In seven studies ACR was compared with 24-hour albumin excretion. The performance of ACR was expressed as a summary diagnostic odds ratio of 45.8 (95% CI 28.5 to 73.4). The use of ACR could save the inconvenience of collecting a timed urine specimen with only a negligible loss of case detection when compared with AER. The ACR data reported in patients with hypertension are similar.

Microalbuminuria predicts ESRD in people with diabetes. Combined estimates of relative risk quoted for microalbuminuria (compared with normoalbuminuria) include an RR of ESRD of 4.8 (95% CI 3.0 to 7.5) in people with type 1 diabetes and 3.6 (95% CI 1.6 to 8.4) in people with type 2 diabetes. Although much of the evidence concerns measures of albuminuria other than ACR, three studies use this measure. Albumin/creatinine ratio is also a marker of renal insufficiency in non-diabetic subjects, and in the Heart Outcomes Prevention Evaluation (HOPE) cohort (subjects with cardiovascular disease, or diabetes and one or more cardiovascular risk factor), baseline microalbuminuria, as detected by ACR, predicted clinical proteinuria in both diabetic and non-diabetic subjects.

In the HOPE cohort and in other studies, microalbuminuria also predicted major cardiovascular events, with an adjusted relative risk of 1.83 (95% CI 1.64 to 2.05) over the period of the study (median 4.5 years). For every 0.4 mg/mmol increase in ACR, the adjusted hazard increased by 5.9%.53-56

Summary of evidence and other considerations

Overall, the evidence suggests that urine dipstick testing cannot reliably be used to diagnose the presence or absence of proteinuria although there is evidence that dipstick proteinuria (≥1+) predicts ESRD and cardiovascular disease. There is no evidence that isolated asymptomatic UTI causes proteinuria/albuminuria. PCR and ACR are accurate rule-out tests in populations with a high probability of proteinuria. PCR and ACR predict subsequent progression of renal disease. ACR has also been shown to predict cardiovascular disease, although similar evidence for PCR was not identified.

The measure of protein excretion that is used in a particular context will be influenced by other considerations. For example, because of its widespread availability, convenience and relatively low cost, urine dipstick testing will often be the initial measure used. Where confirmation is required for diagnostic purposes, the lower cost of PCR should be weighed against the superior accuracy of ACR at low concentrations. The role of microalbuminuria in the detection and management of diabetic nephropathy means that ACR will be preferred in patients with diabetes.

About one third of adults in most communities in the developed and developing world have hypertension. Hypertension is the most common chronic condition dealt with by primary care physicians and other health practitioners.

Most patients with hypertension have other risk factors as well, including lipid abnormalities, glucose intolerance, or diabetes; a family history of early cardiovascular events; obesity; and cigarette smoking. The success of treating hypertension has been limited, and despite well-established approaches to diagnosis and treatment, in many communities fewer than half of all hypertensive patients have adequately controlled blood pressure.

EPIDEMIOLOGY

There is a close relationship between blood pressure levels and the risk of cardiovascular events, strokes, and kidney disease. The risk of these outcomes is lowest at a blood pressure of around 115/75 mm Hg. Above 115/75 mm Hg, for each increase of 20 mm Hg in systolic blood pressure or 10 mm Hg in diastolic blood pressure, the risk of major cardiovascular and stroke events doubles.

The high prevalence of hypertension in the community is currently being driven by two phenomena: the increased age of our population and the growing prevalence of obesity, which is seen in developing as well as developed countries. In many communities, high dietary salt intake is also a major factor. The main risk of events is tied to an increased systolic blood pressure; after age 50 or 60 years, diastolic blood pressure may actually start to decrease, but systolic pressure continues to rise throughout life. This increase in systolic blood pressure and decrease in diastolic blood pressure with aging reflects the progressive stiffening of the arterial circulation. The reason for this effect of aging is not well understood, but high systolic blood pressures in older people represent a major risk factor for cardiovascular and stroke events and kidney disease progression.

HOW IS HYPERTENSION DEFINED

Most major guidelines recommend that hypertension be diagnosed when a person's systolic blood pressure is ≥140 mm Hg or their diastolic blood pressure is ≥90 mmHg, or both, on repeated examination. The systolic blood pressure is particularly important and is the basis for diagnosis in most patients. These numbers apply to all adults older than 18 years, although for patients aged 80 or older a systolic blood pressure up to 150 mm Hg is now regarded as acceptable. The goal of treating hypertension is to reduce blood pressure to levels below the numbers used for making the diagnosis.

These definitions are based on the results of major clinical trials that have shown the benefits of treating people to these levels of blood pressure. Even though a blood pressure of 115/75 mmHg is ideal, as discussed earlier, there is no evidence to justify treating hypertension down to such a low level.

We do not have sufficient information about younger adults (between 18 and 55 years) to know whether they might benefit from defining hypertension at a level <140/90 mmHg (eg, 130/80 mm Hg) and treating them more aggressively than older adults. Thus, guidelines tend to use 140/90 mm Hg for all adults (up to 80 years). Even so, at a practitioner's discretion, lower blood pressure targets may be considered in young adults, provided the therapy is well tolerated.

Some recent guidelines have recommended diagnostic values of 130/80 mm Hg for patients with diabetes or chronic kidney disease. However, the clinical benefits of this lower target have not been established and so these patients should be treated to <140/90 mm Hg.

HOW IS HYPERTENSION CLASSIFIED

For patients with systolic blood pressure between 120 mm Hg and 139 mm Hg, or diastolic pressures between 80 and 89 mm Hg, the term pre-hypertension can be used. Patients with this condition should not be treated with blood pressure medications; however, they should be encouraged to make lifestyle changes in the hope of delaying or even preventing progression to hypertension. Stage 1 hypertension: patients with systolic blood pressure 140 to 159 mm Hg or diastolic blood pressure 90 to 99 mm Hg. Stage 2 hypertension: systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥100 mm Hg.

CAUSES OF HYPERTENSION

Primary Hypertension

About 95% of adults with high blood pressure have primary hypertension (sometimes called essential hypertension). The cause of primary hypertension is not known, although genetic and environmental factors that affect blood pressure regulation are now being studied. Environmental factors include excess intake of salt, obesity, and perhaps sedentary lifestyle. Some genetically related factors could include inappropriately high activity of the renin-angiotensin aldosterone system and the sympathetic nervous system and susceptibility to the effects of dietary salt on blood pressure. Another common cause of hypertension is stiffening of the aorta with increasing age. This causes hypertension referred to as isolated or predominant systolic hypertension characterized by high systolic pressures (often with normal diastolic pressures), which are found primarily in elderly people.

Secondary Hypertension

This pertains to the relatively small number of cases, about 5% of all hypertension, where the cause of the high blood pressure can be identified and sometimes treated. The main types of secondary hypertension are chronic kidney disease, renal artery stenosis, excessive aldosterone secretion, pheochromocytoma, and sleep apnea. A simple screening approach for identifying secondary hypertension is given later.

RHEUMATOID ARTHTITIS

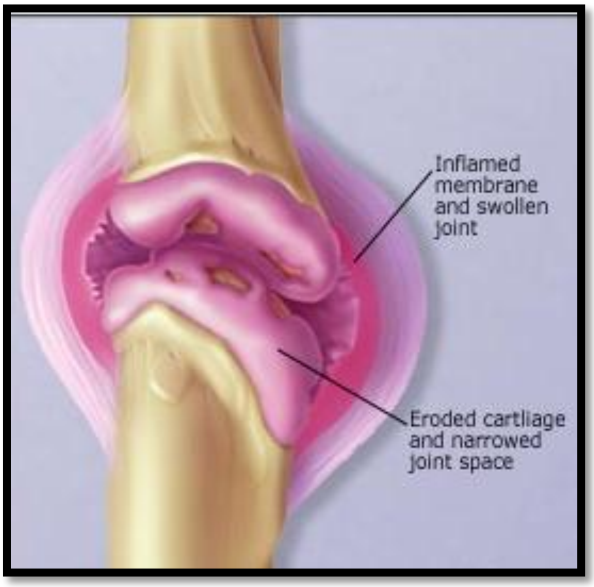


Fig.5: Inflamed membrane and eroded cartilage

Rheumatoid arthritis (RA) is an inflammatory disease that exerts its greatest impact on those joints of the body that are lined with synovium, a specialised tissue responsible for maintaining the nutrition and lubrication of the joint. The distribution of joints affected (synovial joints) is characteristic. It typically affects the small joints of the hands and the feet, and usually both sides equally in a symmetrical distribution, though any synovial joint can be affected. In patients with established and aggressive disease, most joints will be affected over time. The initial trigger for RA is unknown.

There is evidence to suggest abnormalities in components of the immune system that lead to the body developing abnormal immune and inflammatory reactions, particularly in joints. These changes may precede the symptomatic onset of RA by many years. Whatever sets the pathology in motion results in a large increase in blood flow to the joint (giving heat and sometimes redness), proliferation of the synovial membrane with an increase in synovial fluid (swelling), and pain (due to stretching of pain receptors in the soft tissues around, and the bone on either side, of the joint). These features result in rapid loss of muscle around an affected joint, and this, along with pain and swelling lead to loss of joint function. If the inflammation of the synovial membrane cannot be suppressed it will result in increasing damage to the joint, due to the release of protein-degrading enzymes from inflammatory and other cells, and a conversion of parts of the synovial membrane into an inflammatory tissue

called pannus which can invade the bone and cartilage at the margins of the joint. The degree of progressive damage is related to the intensity and duration of the inflammation. Damage to joints results in progressive deformity, disability and handicap. Other structures have synovial linings, such as tendon sheaths, and inflammation of these can result in tendon rupture. Consequently, suppression of inflammation in the early stages of the disease can result in substantial improvements in long-term outcomes for joints and other components of the musculoskeletal system.
Compounding this widespread inflammatory arthritis is the fact that RA affects much more than the joints, and is a systemic disease. In all patients the release of large concentrations of proteins that drive inflammatory processes (such as tumour necrosis factor-α (TNF-α)), result in symptoms of profound fatigue, with a feeling of ongoing influenza-like symptoms, and even fever, sweats and weight loss. Furthermore, other body organ systems may be affected by the inflammatory process, with dryness of the eyes and mouth (Sjögren's syndrome), and nodules (hard lumps particularly over extensor surfaces like the backs of elbows) affecting up to a third of patients.

More significant inflammatory manifestations may lead to serious pathology, such as fibrosis in the lungs, inflammation affecting the lining of the heart and lungs (pleural and pericardial effusions), or vasculitis. Vasculitis results in inflammation of the inner lining of the blood vessels and may lead to potentially devastating effects for whichever organ is supplied by the affected blood vessels. Examples of vasculitis are scleritis of the eye, a painful and potentially sightthreatening vasculitis, and peripheral neuropathy, where nerves are irreversibly damaged leading to weakness or sensory abnormalities. Inflammation of the joints can also be life threatening when it affects the neck, causing potentially unstable articulations between the bones, and inflammatory pannus. This combination of bone deformity and swollen inflammatory tissue can press on the spinal cord, leading to ischaemia and widespread neurological consequences affecting all four limbs, bowel and bladder function, or the respiratory muscles and centres in the brain stem that control respiration, potentially resulting in death.

Thankfully, these life-threatening inflammatory manifestations of disease are uncommon, and are possibly becoming rarer. However, it has become increasingly evident that the ongoing inflammation and loss of mobility can have other unforeseen circumstances for people with RA. Heart conditions such as ischaemic heart disease and cardiac failure have been shown to be more common in RA, and result in

premature death for many patients. Atherosclerosis (where the inner lining of arteries become progressively thickened and impair blood supply to whichever organ is being served) is driven in part by ongoing inflammation, so that the people with the most active RA have the greatest risk of heart disease. Osteoporosis is also more common, due to reduced mobility, inflammation, and sometimes the drugs they are on (particularly steroids). People with RA are more prone to infections than the rest of the population, probably due to abnormalities in the immune system, and sometimes contributed to by medication (such as the immunosuppressant effects of steroids).
Clearly RA has the potential for not only widespread joint and soft tissue damage, but also inflammatory processes that can directly or indirectly affect most organ systems in the body, and result in premature death. Appropriate management therefore needs to address not only the impact on joints, but also focus on the whole body, the person suffering from the disease, their families and where appropriate their employers.

Definition

The most commonly used classification criteria for RA were drawn together in 1987 by a committee of the American College of Rheumatology 2 and published as 'The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. It is important to note that these are classification criteria and not diagnostic criteria. In other words, they were designed to facilitate communication between researchers, and ensure more robust research through reliable case definition, so that irrespective of where a study is taking place, everybody means the same thing by the term 'RA'. They are not diagnostic criteria (although commonly misnamed as such), because there are no diagnostic tests for RA that differentiate it from normality or from other types of arthritis. The diagnosis is therefore largely a clinical one, relying particularly in the early stages on the history and examination of the patient, with tests (blood or imaging) sometimes helping to confirm the most likely diagnosis.
The 1987 ACR criteria were not designed for clinical practice, although they do influence the way that clinicians think of RA, and do appear in national clinical guidelines. However, they are not useful in discriminating between RA and self-limiting disease in early synovitis that might evolve eventually into disease that fulfils the criteria for RA. They also exclude some individuals with a polyarthritis that does not quite fulfil the criteria, but whose disease closely resembles RA, and has a similar course and response to treatments.

Rheumatoid arthritis

For the purposes of this guideline, the guideline development group (GDG) accepted a clinical diagnosis of RA as being more important than the 1987 classification criteria for RA,2 because an early persistent synovitis where other pathologies have been ruled out needs to treated as if it is RA to try to prevent damage to joints. Identification of persistent synovitis and appropriate early management is more important than whether the disease satisfies classification criteria.3 The GDG was therefore keen to take a pragmatic approach and include consideration of all patients with a recent-onset or established inflammatory arthritis where other underlying pathologies had been excluded.

WAVEFORMS

This chapter will present methods of generating waveforms. Before you begin to study how waveforms are generated, you need to know the basic characteristics of waveforms. This section will discuss basic periodic waveforms.

PERIODIC WAVEFORMS

A waveform which undergoes a pattern of changes, returns to its original pattern, and repeats the same pattern of changes is called a PERIODIC waveform. Periodic waveforms are nonsinusoidal except for the sine wave. Periodic waveforms which will be discussed are the sine wave, square wave, rectangular wave, sawtooth wave, trapezoidal wave, and trigger pulses.

Sine Wave

Each completed pattern of a periodic waveform is called a CYCLE, as shown by the SINE WAVE in figure 3-1, view (A). Sine waves were presented in NEETS

Square Wave

A SQUARE WAVE is shown in figure 3-1, view (B). As shown, it has two alternations of equal duration and a square presentation for each complete cycle. Figure 3-2 shows a breakdown of the square wave and is the figure you should view throughout the square wave discussion. The amplitude is measured vertically. The time for a complete cycle is measured between corresponding points on the wave (T0 to T2, or T1 to T3).

Rectangular Wave

A rectangular wave is similar to the square wave. The difference is that in the rectangular waveform, the two alternations of the waveform are of unequal time duration. Fig 6, view (C), shows that the negative alternation (pulse) is shorter (in time) than the positive alternation. The negative alternation could be represented as the longer of the two alternations. Either way, the appearance is that of a rectangle.

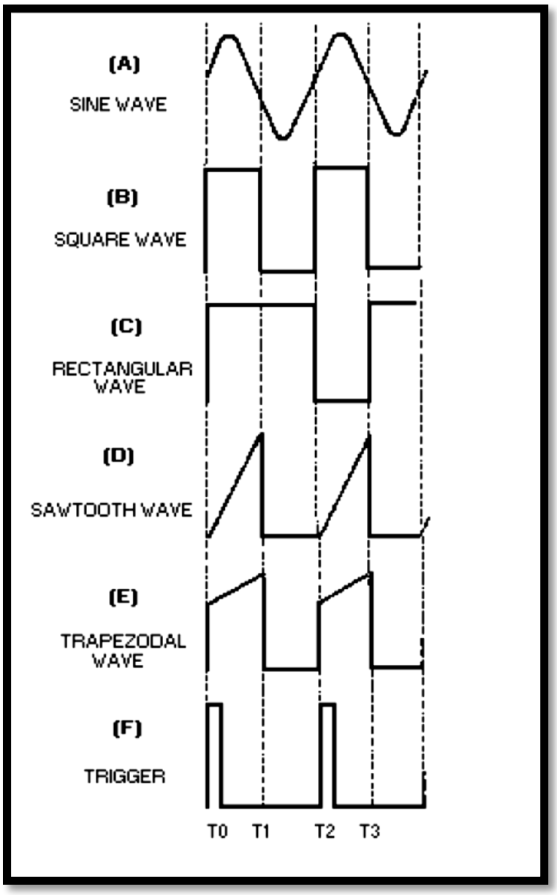


Fig.6: Periodic Waveforms

Sawtooth Wave

The SAWTOOTH waveform is shown in figure 3-1, view (D). A sawtooth wave resembles the teeth of a saw blade. There is a rapid vertical rise of voltage from T0 to T1, which is linear (straight). At T1 this voltage abruptly falls (essentially no time used) to its previous static value. The voltage remains at this value until T2 when it again has a linear rise. You can see this action in an oscilloscope where there are two voltage input locations, vertical and horizontal. If you apply a linear voltage to the vertical input, the electron beam will be forced to move in a vertical direction on the crt. A linear voltage applied to the horizontal input will cause the electron beam to move horizontally across the crt. The application of two linear voltages, one to the vertical input and one to the horizontal input at the same time, will cause the 3-5 beam to move in both a vertical and horizontal (diagonal) direction at the same time. This then is how a sawtooth wave is made to appear on an oscilloscope. You should refer to NEETS, Module 6, *Electronic Emission, Tubes, and Power Supplies*, for a review of oscilloscopes.

Trapezoidal Wave

A TRAPEZOIDAL wave looks like a sawtooth wave on top of a square or rectangular wave. The leading edge of a trapezoidal wave is called the JUMP voltage. The next portion of the wave is the linear rise or SLOPE. The trailing edge is called the FALL or DECAY. A trapezoidal wave is used to furnish deflection current in the electromagnetic cathode ray tube and is found in television and radar display systems. Electromagnetic cathode ray tubes use coils for the deflection system, and a linear rise in current is required for an accurate horizontal display. The square or rectangular wave portion provides the jump voltage for a linear rise in current through the resistance of the coil. This will be explained further in a discussion of the trapezoidal sweep generator.

Triggers

A trigger is a very narrow pulse, as shown in figure 3-1, view (F). Trigger pulses are normally used to turn other circuits on or off.

WAVEFORM GENERATOR

Nonsinusoidal oscillators generate complex waveforms such as those just discussed. Because the outputs of these oscillators are generally characterized by a sudden change, or relaxation, these oscillators are often called RELAXATION OSCILLATORS. The pulse repetition rate of these oscillators is usually governed by the charge and discharge timing of a capacitor in series with a resistor. However, some oscillators contain inductors that, along with circuit resistance, affect the output frequency. These RC and LC networks within oscillator circuits are used for frequency determination. Within this category of relaxation oscillators are MULTIVIBRATORS, BLOCKING OSCILLATORS, and SAWTOOTH- and TRAPEZOIDAL-WAVE GENERATORS.

Many electronic circuits are not in an "on" condition all of the time. In computers, for example, waveforms must be turned on and off for specific lengths of time. The time intervals vary from tenths of microseconds to several thousand microseconds. Square and rectangular waveforms are normally used to turn such circuits on and off because the sharp leading and trailing edges make them ideal for timing purposes.

MULTIVIBRATORS

The type of circuit most often used to generate square or rectangular waves is the multivibrator. A multivibrator, as shown in figure 3-3, is basically two amplifier circuits arranged with regenerative feedback. One of the amplifiers is conducting while the other is cut off.

Astable Multivibrator.

When an input signal to one amplifier is large enough, the transistor can be driven into cutoff, and its collector voltage will be almost V CC. However, when the transistor is driven into saturation, its collector voltage will be about 0 volts. A circuit that is designed to go quickly from cutoff to saturation will produce a square or rectangular wave at its output. This principle is used in multivibrators. Multivibrators are classified according to the number of steady (stable) states of the circuit. A steady state exists when circuit operation is essentially constant; that is, one transistor remains in conduction and the other remains cut off until an external signal is applied. The three types of multivibrators are the ASTABLE, MONOSTABLE, and BISTABLE.

The astable circuit has no stable state. With no external signal applied, the transistors alternately switch from cutoff to saturation at a frequency determined by the RC time constants of the coupling circuits. The monostable circuit has one stable state; one transistor conducts while the other is cut off. A signal must be applied to change this condition. After a period of time, determined by the internal RC components, the circuit will return to its original condition where it remains until the next signal arrives.

The bistable multivibrator has two stable states. It remains in one of the stable states until a trigger is applied. It then FLIPS to the other stable condition and remains there until another trigger is applied. The multivibrator then changes back (FLOPS) to its first stable state.

Astable Multivibrator

An astable multivibrator is also known as a FREE-RUNNING MULTIVIBRATOR. It is called free running because it alternates between two different output voltage levels during the time it is on. The 3-7 output remains at each voltage level for a definite period of time. If you looked at this output on an oscilloscope, you would see continuous square or rectangular waveforms. The astable multivibrator has two outputs, but NO inputs. Let's look at the multivibrator in figure 3-3 again. This is an astable multivibrator. The astable multivibrator is said to oscillate. To understand why the astable multivibrator oscillates, assume that transistor Q1 saturates and transistor Q2 cuts off when the circuit is energized. This situation is shown in figure 3-4. We assume Q1 saturates and Q2 is in cutoff because the circuit is symmetrical; that is, R1 = R4, R2 = R3, C1 = C2, and Q1 = Q2. It is impossible to tell which transistor will actually conduct when the circuit is energized. For this reason, either of the transistors may be assumed to conduct for circuit analysis purposes.

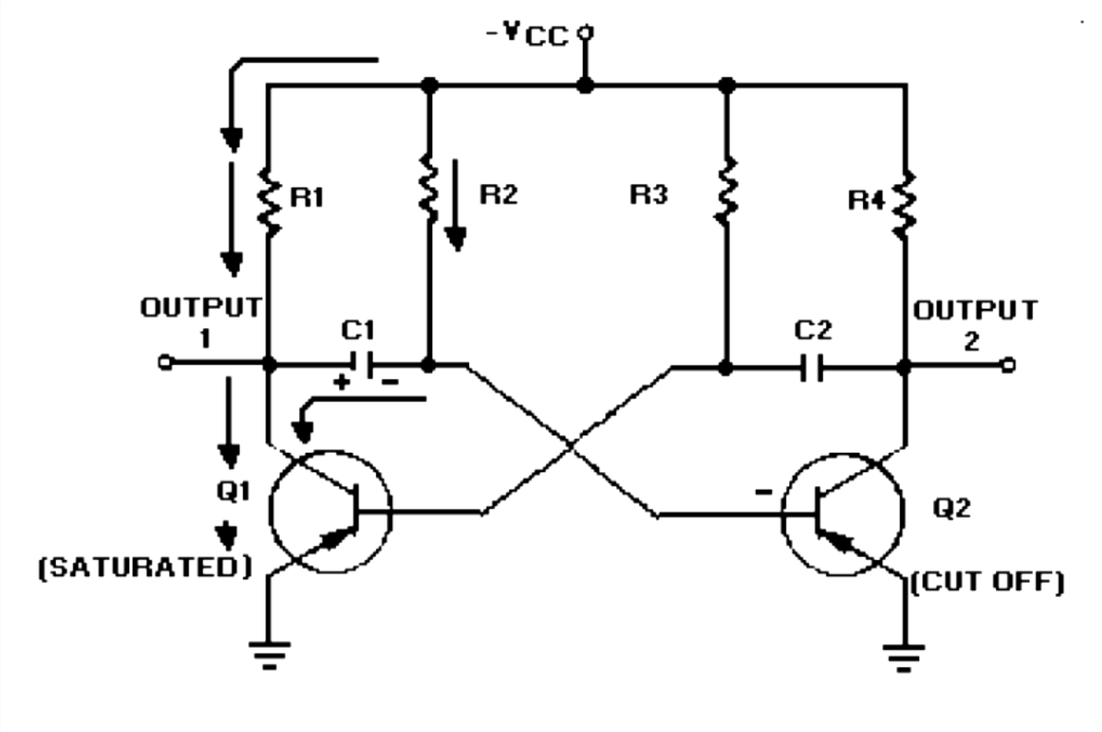


Fig.7: Astable multivibrator (Q1 Saturated)

Essentially, all the current in the circuit flows through Q1; Q1 offers almost no resistance to current flow. Notice that capacitor C1 is charging. Since Q1 offers almost no resistance in its saturated state, the rate of charge of C1 depends only on the time constant of R2 and C1 (recall that TC = RC). Notice that the right-hand side of capacitor C1 is connected to the base of transistor Q2, which is now at cutoff.

Let's analyze what is happening. The right-hand side of capacitor C1 is becoming increasingly negative. If the base of Q2 becomes sufficiently negative, Q2 will conduct. After a certain period of time, the base of Q2 will become sufficiently negative to cause Q2 to change states from cutoff to conduction. The time necessary for Q2 to become saturated is determined by the time constant R2C1[4].

PERIODICITY

Music perception and composition seem to be influenced not only by convention or culture, manifested by musical styles or composers, but also by the psychophysics of tone perception. Thus, in order to better understand the process of musical creativity and information retrieval, the following questions should be addressed:

• What are underlying (psychophysical) principles of music perception

• How can the perceived sonority of chords and scales, in particular of western music, be explained? Therefore, in the rest of this section (Sect. 1), we will introduce basic musical notions and results. After that, we will briefly review existing psychophysical theories on harmony perception (Sect. 2), which are often based on the notions dissonance and tension, taking harmonic overtone spectra into account. In contrast to this, the approach presented here (Sect. 3) is simply based on the periodicity of chords. Applying this theory to common musical chords and also scales (Sect. 4), shows a very good correlation to empirical results, that e.g. most subjects prefer major to minor chords. Finally, we will highlight the psychophysical basis of the proposed approach, by reviewing some recent results from neuro-science on periodicity detection of the brain, and end up with conclusions.

Basic Musical Notions

Before we are able to address the problem of harmony perception, we should clarify the terminology we use. For this, we follow the lines of [2]. The basic entity we have to deal with is a *tone*: A *pure* tone is a tone with a sinusoidal waveform.

It has a specific pitch, corresponding to its perceived *frequency* f, usually measured in Hertz (Hz), i.e. periods per second. In practice, pure tones almost never appear. The tones produced by real instruments like strings, tubes, or the human voice have harmonic or other *overtones*. The frequencies of harmonic overtones are integer multiples of a fundamental frequency f. For the frequency of the n-th overtone ($n \geq 1$), it holds $f_n = n \cdot f$, i.e. $f_1 = f$. The amplitudes of the overtones define the *spectrum* of a tone or sound and account for its loudness and specific timbre.

A *harmony* in an abstract sense can be identified by a set of tones forming an interval, chord, or scale. Two tones define an *interval*, which is the distance between two pitch categories. The most prominent interval is the *octave*, corresponding to a frequency ratio of 2/1. Since the same names are assigned to notes an octave apart, they are assumed to be *octave equivalent*. An octave is usually divided into 12 semitones in western music, corresponding to a frequency ratio of 1√2 2 in equal temperament (cf. Sect. 3.3). Thus, intervals may also be defined by the number of semitones between two tones. A *chord* is a complex musical sound comprising three or more simultaneous tones, while a *scale* is a set of musical notes, whose corresponding tones usually sound consecutively. Both can be identified by the numbers of semitones in the harmony.

A *triad* is a chord consisting of three tones. Classical triads are built from major and minor thirds, i.e., the distance between successive pairs of tones are 3 or 4 semitones. For example, the major triad consists of the semitones {0,4,7}, which is the *root position* of this chord. An *inversion* of a chord is obtained by transposing the currently lowest tone by an octave. Fig. 8 (a) shows the three inversions of the E major chord, including the root position. Fig. 8 (b)–(e) shows all triads that can be build from thirds including their inversion, always with *e′* as lowest tone. Fig. 8 (f) shows the suspended chord, built from perfect fourths (5 semitones). Its last inversion, consisting of the semitones {0,5,10}, reveals this.

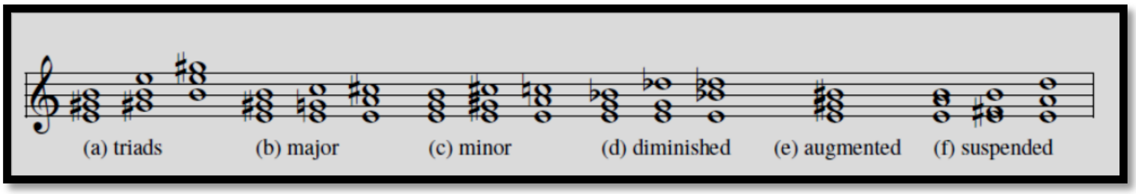


Fig.8: Inversions of E major chord

2. THEORIES ON HARMONY PERCEPTION

Chord classes lead to different musical modes. The major chord is often associated with emotional terms like *happy*, *strong*, or *bright*, and, in contrast to this, the minor chord with terms like *sad*, *weak*, or *dark*. Empirical results (see e.g. [4]) reveal preference ordering on the perceived sonority of the triads as follows: major, minor , diminished ,augmented. Since all these triads are built from thirds, thirds do not provide an explanation of this preference ordering on its own. Therefore, let us now review existing theories on harmony perception, discussing some of their merits and drawbacks.

3. A PERIODICITY-BASED THEORY

The approaches discussed so far more or less take the frequency spectrum of a sound as their starting point. Obviously, analyzing the frequency spectrum is closely related to analyzing the time domain (periodicity). Fourier transformation allows to translate between both mathematically. However, subjective pitch detection, i.e., the capability of our auditory system to identify the repetition rate (periodicity) of a complex tone sensation, only works for the lower but musically important frequency range up to about 1.500Hz [3]. In consequence, a *missing fundamental* tone can be assigned to each interval. The tone with the respective frequency, called *virtual pitch* of the interval, is not present as an original tone component. It has nothing to do with (first-order) beats and is perceived not directly in the ear, but in the brain.

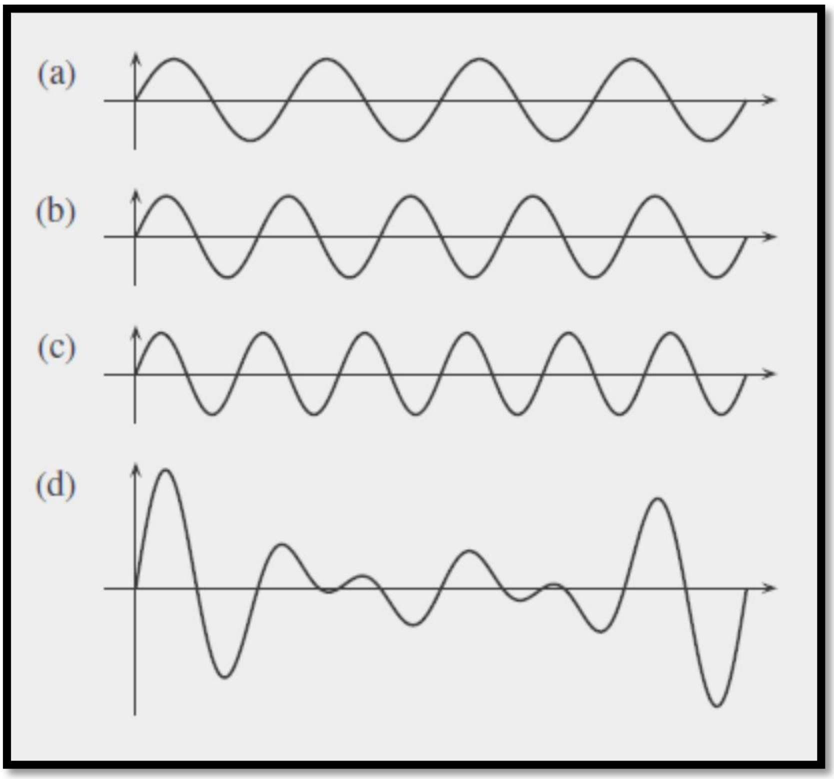


Fig.9: Periodicity of Pitches

3.1 Periodicity Pitch of Chords

For intervals, i.e. two tones, the concept of virtual pitch has been studied many times in the literature (see [3] and references therein). The idea in this paper now is to transfer this concept to chords by considering *relative periodicity*, i.e. the period length of complex sinusoids relative to the period length of the frequency of the lowest tone component (cf. [7, Sect. 7.1]). For example, the A major triad in just intonation consists of three tones with (absolute) frequencies $f1$ = 440Hz, $f2$ = 550Hz, and $f3$ = 660Hz. The respective frequency ratios wrt. the lowest tone (a') are $F1 = 1/1$, $F2 = 5/4$ (third), and $F3 = 3/2$ (fifth), corresponding to the semitones {0,4,7}. Fig. 2 (a)-(c) show the sinusoids for the three pure tone components and Fig. 2 (d) their superposition, i.e. the graph of the function sin(w1t)+sin(w2t)+sin(w3t), where wi = 2p fi are the respective angular frequencies, and t is the time. As one can see, the period length of the chord is (only) four times the period length of the lowest tone for this example. In the following, we call this ratio h. It depends on the frequency ratios $\{a1/b1, \ldots, ak/bk\}$ of the given chord.

We assume, that each frequency ratio Fi is a fraction ai/bi (in its lowest terms), because otherwise no finite period length can be found in general, and it holds $Fi \approx fi/f1$ for $1 \leq i \leq k$. This means, all frequencies are relativized to the lowest frequency $f1$, and $F1 = 1$. The value of h then can be computed as lcm($b1, \ldots, bk$), i.e., it is the *least common multiple* (lcm) of the denominators of the frequency ratios. This can be seen as follows: Since the relative period length of the lowest tone $T1 = 1/F1$ is 1, we have to find the smallest integer number that is an integer multiple of all relative period lengths $Ti = 1/Fi = bi/ai$ for $1 < i \leq k$. Since after ai periods of the i-th tone, we arrive at the integer bi, h can be computed as the least common multiple of all bi.

3.2 A Hypothesis on Harmony Perception

We now set up the following hypothesis on harmony perception: The perceived sonority of a chord, called *harmonicity* in this context, decreases with the value of h. For the major triad in root position we have $h = 4$ (see above), which is quite low. Therefore, its predicted sonority is high. This correlates well to the empirical results, in general better than the approaches discussed in the previous section (Sect. 2), as we will see later on (in Sect. 4). In addition, the periodicity-based theory presented here is computationally simple, because it needs no assumptions on parameters, such as harmonic overtone spectra. Neither complex summation nor computing local extrema is required. Only the frequency ratios of the tone components in the chord are needed as input parameters. But we still have to answer the question, which frequency ratios should be used in the computation of h. Since this is done in a special way here, we present this now in more detail.

3.3 Tuning and Frequency Ratios

The frequencies for the k-th semitone in *equal temperament* with twelve tones per octave can be computed as $fk = 1\sqrt{2}\ 2k \cdot f1$, where $f1$ is the frequency of the lowest tone. The respective frequency ratios are shown in Tab. 1 (a). The values grow exponentially and not linearly, following the *Weber-Fechner law* in psychophysics, which says that, if the physical magnitude of stimuli grows exponentially, then the perceived intensity grows only linearly. In equal temperament, all keys sound equal. This is essential for playing in different keys on one instrument and for modulation, i.e. changing from one key to another within one piece of music. Since this seems to be universal, at least in western music, we will adopt the equal temperament as *reference system* for other tunings. The frequency ratios in equal temperament are irrational numbers (except for the ground tone and its octaves), but for periodicity detection they must be fractions, as mentioned above. Let us thus consider other tunings with rational frequency ratios. The oldest tuning with this property is probably the *Pythagorean tuning*, shown in Tab. 1 (b). Here, frequency relationships of all intervals have the form $3m/2n$ for some integers m and n, i.e., they are based on fifths, strictly speaking, a stack of perfect fifths (frequency ratio 3/2), applying octave equivalence.

However, although huge numbers appear in the numerators and denominators of the fractions in Pythagorean tuning, the relative errors compared to equal temperament (shown in brackets in Tab. 1) grow up to more than 1%. In fact, the Pythagorean tuning does not follow results of psychophysics, namely that human subjects can distinguish frequency differences for pure tone components only up to a certain resolution, namely 0.5% under optimal conditions. For the musically important low frequency range, especially the tones in (accompanying) chords, this so-called *just noticeable difference* is worse, namely only below about 1% [3]. Therefore, we should look for tunings, where the relative error is approximately 1%. In addition, the frequency ratios should be simple integer ratios, i.e. fractions with small numerators and denominators. In order to achieve the latter, we can look in the harmonic overtone sequence,when a tone of the chromatic scale appears for the first time, applying again octave equivalence.

The result of this procedure, which we will call *overtonal tuning*, leads to frequency ratios of the form $m/2n$ for some integers m and n as shown in Tab. 1 (c). However, as one can see, the relative error compared to equal temperament again is sometimes high. In the literature (see e.g. [5] and references therein), other historical and modern tunings are listed, e.g. *Kirnberger III*, see Tab.1 (d). However, they are also only partially useful in this context, because they do not take into account the fact on just noticeable differences explicitly. In principle, this also holds for the adaptive tunings in [5], where simple integer ratios are used and scales are allowed to vary. An adaptive tuning can be viewed as a generalized dynamic *just intonation*, which fits well to musical practice, because the frequencies for one and the same pitch category may vary significantly during the performance of a piece of music. Trained musicians try to intonate e.g. a perfect fifth with the frequency ratio 3/2, and listeners are hardly able to distinguish this frequency ratio from others that are close to the value in equal temperament, namely 1√2 27 ≈ 1.498. In consequence, also the *rational tuning*, which we introduce now, primarily should not be considered as a tuning, but more as the basis for intonation and perception of intervals. We will use the frequency ratios of the rational tuning, shown in Tab. 1 (e), in our analyses of harmonicity. They are fractions with smallest possible denominator, such that the relative error wrt. equal temperament is just below 1%. They can be computed by means of *Farey sequences*, i.e. ordered sequences of completely reduced fractions between 0 and 1 which have denominators less than or equal to some (small) n, or by continued fraction expansion[5].

Table.2

interval	k	(a) equal temperament	(b) Pythagorean	(c) overtonal	(d) Kirnberger III	(e) rational
prime, unison	0	1.000	1/1 (0.00%)	1/1 (0.00%)	1/1 (0.00%)	1/1 (0.00%)
minor second	1	1.059	$3^7/2^{11}$ (0.79%)	17/16 (0.29%)	25/24 (–1.68%)	16/15 (0.68%)
major second	2	1.122	9/8 (0.23%)	9/8 (0.23%)	9/8 (0.23%)	9/8 (0.23%)
minor third	3	1.189	$3^9/2^{14}$ (1.02%)	19/16 (–0.14%)	6/5 (0.91%)	6/5 (0.91%)
major third	4	1.260	81/64 (0.45%)	5/4 (–0.79%)	5/4 (–0.79%)	5/4 (–0.79%)
perfect fourth	5	1.335	$3^{11}/2^{17}$ (1.25%)	21/16 (–1.67%)	4/3 (–0.11%)	4/3 (–0.11%)
tritone	6	1.414	$3^6/2^9$ (0.68%)	23/16 (1.65%)	45/32 (–0.56%)	17/12 (0.17%)
perfect fifth	7	1.498	3/2 (0.11%)	3/2 (0.11%)	3/2 (0.11%)	3/2 (0.11%)
minor sixth	8	1.587	$3^8/2^{12}$ (0.91%)	25/16 (–1.57%)	25/16 (–1.57%)	8/5 (0.79%)
major sixth	9	1.682	27/16 (0.34%)	27/16 (0.34%)	5/3 (–0.90%)	5/3 (–0.90%)
minor seventh	10	1.782	$3^{10}/2^{15}$ (1.14%)	7/4 (–1.78%)	16/9 (–0.23%)	16/9 (–0.23%)
major seventh	11	1.888	243/128 (0.57%)	15/8 (–0.68%)	15/8 (–0.68%)	15/8 (–0.68%)
octave	12	2.000	2/1 (0.00%)	2/1 (0.00%)	2/1 (0.00%)	2/1 (0.00%)

PITCH AND SPECTROGRAM

Separation of sound sources is a key phase in many audio analysis tasks since real-world acoustic recordings often contain multiple sound sources. Humans are extremely skillful in "hearing out" the individual sources in the acoustic mixture. A similar ability is usually required in computational analysis of acoustic mixtures. For example in automatic speech recognition, additive interference has turned out to be one of the major limitations in the existing recognition algorithms.

A significant amount of existing monaural (one-channel) source separation algorithms are based on either pitch-based inference or spectrogram factorization techniques. Pitch-based inference algorithms (see Section 2.1 for a short review) utilize the harmonic structure of sounds, estimate the time-varying fundamental frequencies of sounds, and apply this in the separation. Spectrogram factorization techniques (see Section 2.2), on the other hand, utilize the redundancy of the sources by decomposing the input signal into a sum of repetitive components, and then assign each component to a sound source. This paper proposes a hybrid system where pitch-based inference is combined with unsupervised spectrogram factorization in order to achieve a better separation quality of vocal signals in accompanying polyphonic music. The hybrid system proposed in Section 3 first estimates the fundamental frequency of the vocal signal. Then a binary mask is generated which covers time-frequency regions where the vocal signals are present. A non-negative spectrogram factorization algorithm is applied on the non-vocal regions. This stage produces an estimate of the contribution of the accompaniment in the vocal regions of the spectrogram using the redundancy in accompanying sources.

The estimated accompaniment can then be subtracted to achieve better separation quality, as shown in the simulations in Section 4. The proposed system was also tested in aligning separated vocals with textual lyrics, where it produced better results than the previous algorithm.

2.1. Pitch-based inference

Voiced vocal signals and pitched musical instrument are roughly harmonic, which means that they consist of harmonic partials at approximately integer multiples of the fundamental frequency f0 of the sound. An efficient model for these sounds is the sinusoidal model, where each partial is represented with a sinusoid with time-varying frequency, amplitude and phase. There are many algorithms for estimating the sinusoidal modeling parameters. A robust approach is to first estimate the time-varying fundamental frequency of the target sound and then to use the estimate in obtaining more accurate parameters of each partial. The target vocal signal can be assumed to have the most prominent harmonic structure in the mixture signal, and there are algorithms for estimating the most prominent fundamental frequency over time, for example [1] and [2]. Partial frequencies can be assumed to be integer multiples of the fundamental frequency, but for example Fujihara et al. [3] improved the estimates by setting local maxima of the power spectrum around the initial partial frequency estimates to be the exact partial frequencies. Partial amplitudes and phases can then be estimated for example by picking the corresponding values from the amplitude and phase spectra.

Once the frequency, amplitude, and phase have been estimated for each partial in each frame, they can be interpolated to produce smooth amplitude and phase trajectories over time. For example, Fujihara et al. [3] used quadratic interpolation of phases. Finally the sinusoids can be generated and summed to produce an estimate of the vocal signal.

The above procedure produces good results especially when the accompanying sources do not have significant amount of energy at the partial frequencies. A drawback in the above procedure is that it assigns all the energy at partial frequencies to the target source. Especially in the case of music signals, sound sources are likely to appear in harmonic relationships so that many of the partials have the same frequency. Furthermore, unpitched sounds may have a significant amount of energy at high frequencies, some of which overlaps with the partial frequencies of the target vocals. This causes the partial amplitudes to be overestimated and distorts the spectrum of separated vocal signal. The phenomenon has been addressed for example by Goto [2] who used prior distributions for the vocal spectra.

2.2. Spectrogram factorization

Recently, spectrogram factorization techniques such as non-negative matrix factorization (NMF) and its extensions have produced good results in sound source separation [4]. The algorithms employ the redundancy of the sources over time: by decomposing the signal into a sum of repetitive spectral components they lead to a representation where each sound source is represented with a distinct set of components.

The algorithms typically operate on a phase-invariant timefrequency representation such as the magnitude spectrogram. We denote the magnitude spectrogram of the input signal by X, and its entries by Xk,m, where k = 1, . . . ,K is the discrete frequency index and m = 1, . . . ,M is the frame index. In NMF the spectrogram is approximated as a product of two element wise non-negative matrices, X ≈ SA, where the columns of matrix S contain the spectra of components and the rows of matrix A their gains in each frame. S and A can be efficiently estimated by minimizing a chosen error criterion between X and the product SA, while restricting their entries to non-negative values. A commonly used criterion is the divergence

$$D(X\|SA) = \sum_{k=1}^{K} \sum_{m=1}^{M} d\,(X_{k,m}\ [SA]_{k.m})$$

where the divergence function d is defined as

$d(p, q) = p \log(p/q) - p + q.$ (2)

Once the components have been learned, those corresponding to the target source can be detected and further analyzed. A problem in the above method is that it is only capable of learning and separating redundant spectra in the mixture. If a part of the target sound is present only once in themixture, it is unlikely to be well separated.

In comparison with the accompaniment in music, vocal signals have typically more diverse spectra. The fine structure of the short-time spectrum of a vocal signal is determined by its fundamental frequency and the rough shape of the spectrum is determined by the phonemes, i.e, sung words. In practice both of these vary as a function of time. Especially when the input signal is short, the above properties make learning of all the spectral components of the vocal signal a difficult task. The above problem has been addressed for example by Raj et al. [5], who trained a set of spectra for the accompaniment using non-vocal segments which were manually annotated. Spectra of the vocal part was then learned from the mixture by keeping the accompaniment spectra fixed. Slightly similar approach was used by Ozerov et al. [6] who segmented the signal to vocal and non-vocal segments, and then a priorly trained background model was adapted using the non-vocal segments. The above methods require temporal non-vocal segments where the accompaniment is present without the vocals.

3. Proposed hybrid method

To overcome the limitations in the pitch-based and unsupervised learning approaches, we propose a hybrid system which utilizes the advantages of the both approaches. The block diagram of the system is presented in Figure 1. In the right processing branch, pitch-based inference and a binary mask is first used to identify time-frequency regions where the vocal signal is present, as explained in Section 3.1. Non-negative matrix factorization is then applied on the remaining non-vocal regions in order to learn an accompaniment model, as explained in Section 3.2. This stage also predicts the spectrogram of the accompanying sounds on the vocal segments. The predicted accompaniment is then subtracted from the vocal spectrogram regions, and the remaining spectrogram is inverted to get an estimate of the time-domain vocal signal.

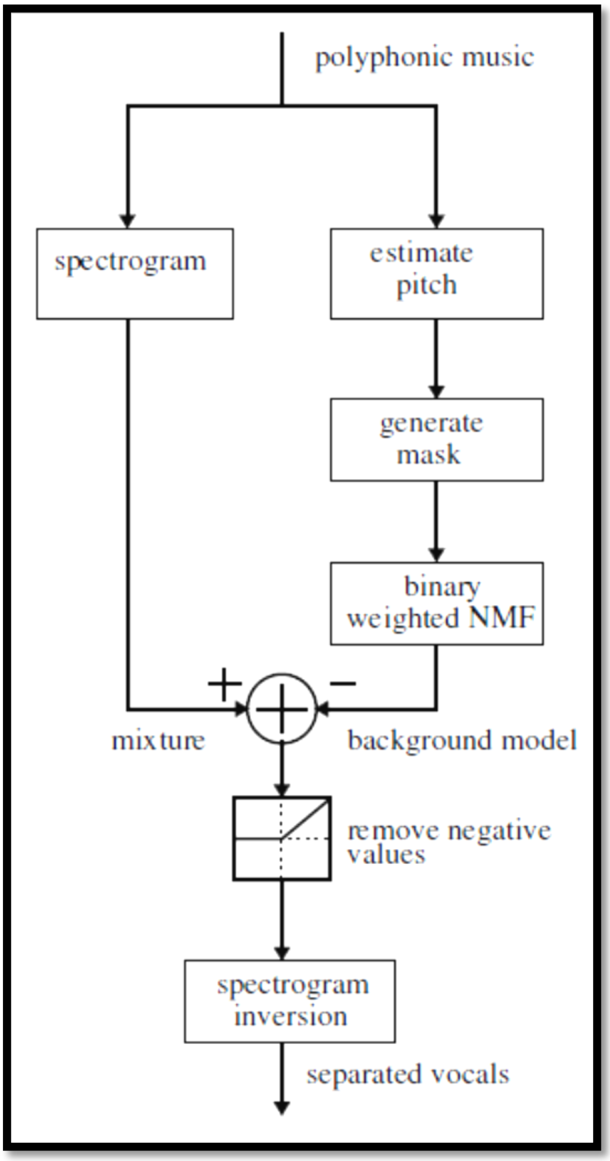


Fig.10: Hybrid Method

3.1. Pitch-based binary mask

A pitch estimator is first used to find the time-varying pitch of vocals in the input signal. Our main target in this work is music signals, and we found that the melody transcription algorithm of Ryynänen and Klapuri [7] produced good results in the pitch estimation. To get an accurate estimate of time-varying pitches, local maxima in the fundamental frequency salience function [7] around the quantized pitch values were interpreted as the exact pitches. The algorithm produces a pitch estimate at each 20 ms interval. Based on the estimated pitch, time-frequency regions of the vocals are predicted. The accuracy of the pitch estimation algorithm was found to be good enough so that the partial frequencies were assigned to be exactly integer multiples of the estimated pitch. The NMF operates on the magnitude spectrogram obtained by short-time discrete Fourier transform (DFT), where DFT length is equal to N, the number of samples in each frame. Thus, the frequency axis of the spectrogram consist of a discrete set of frequencies fsk/N, where k = 0, . . . ,N/2, since frequencies are used only up to the Nyquist frequency. In each frame, a fixed frequency region around each predicted partial frequency is then marked as a vocal region. In our system, a 50 Hz bandwidth around the predicted partial frequencies f was marked as the vocal region, meaning that if the frequency bin was within the 50 Hz interval, it was marked as the vocal region. On N = 1764, this leads to two or three frequency bins around the partial frequency marked as vocal segment, depending on the alignment between the partial frequency and the discrete frequency axis. In practice, a good bandwidth around each partial depends at least on the window length, which was 40 ms in our implementation. The pitch estimation stage can also produce an estimate of voice activity. For unvoiced frames all the frequency bins are marked as non-vocal regions. Once the above procedure is applied in each frame, we obtain a K-by-M binary mask W where each entry indicates the vocal activity (0=vocals, 1=no vocals). An example of a binary mask is illustrated in Figure 11.

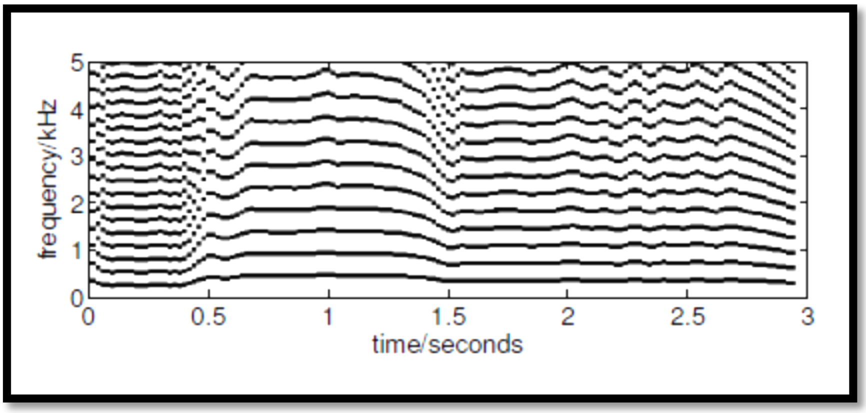


Fig.11: Pitch based Binary Mask

3.3. Vocal spectrogram inversion

The magnitude spectrogram V of vocals is reconstructed as

$$V = [\max(X - SA, 0)] \otimes (1 - W), \quad (12)$$

where 1 is K-by-M matrix which all entries equal 1. The operation $X - SA$ subtracts the estimated background from the observed mixture, and it was found advantageous to restrict this value above zero by the element-wise maximum operation. Element-wise multiplication by $(1-W)$ allows non-zero magnitude only in the estimated vocal regions. The magnitude spectrogram of the background signal can be obtained as $X - V$. Figure 12 shows example spectrograms of a polyphonic signal, its separated vocals and background. Time-varying harmonic combs corresponding to voiced parts of the vocals present in the mixture signal are mostly removed from the estimated background. Complex spectrogram is obtained by using the phases of the original mixture spectrogram, and finally the time-domain vocal signal can be obtained by overlap-add[6].

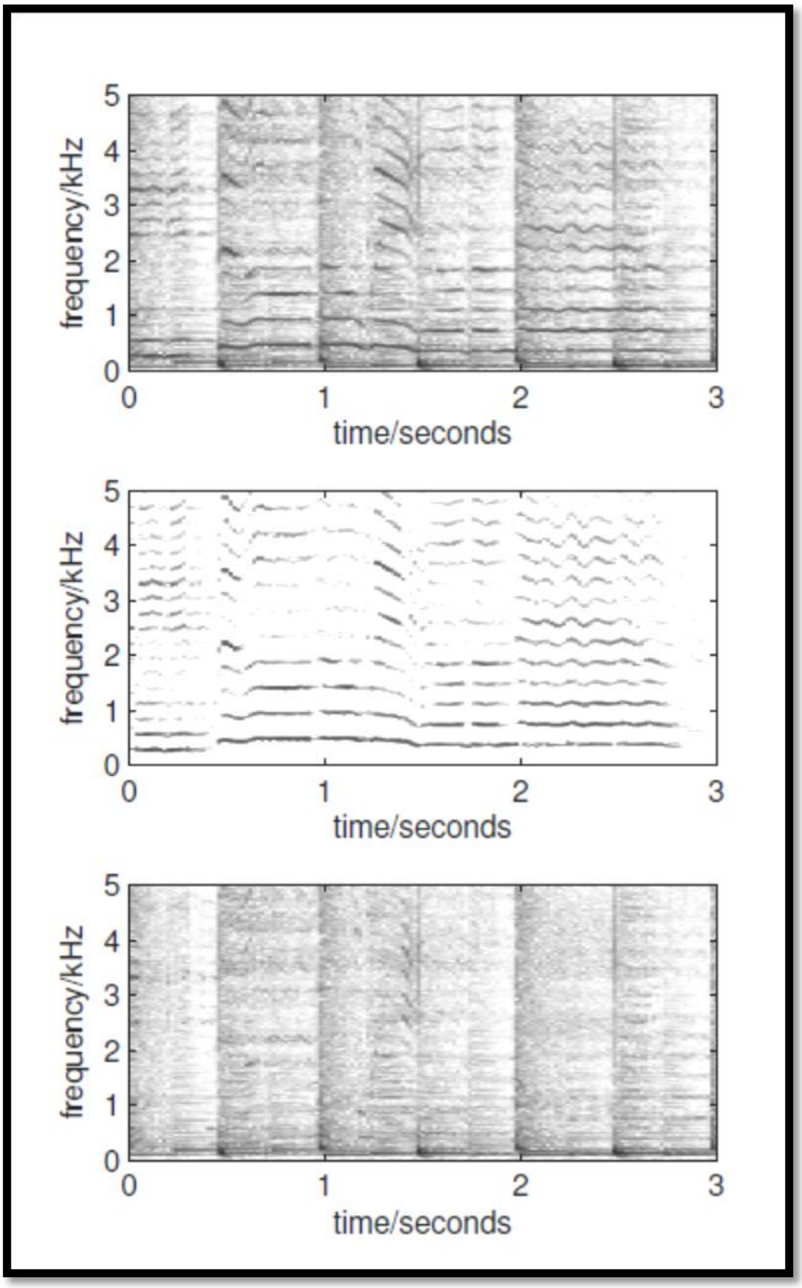


Fig.12: Spectrograms of a polyphonic example mixture signal (top), separated vocals (middle) and separated accompaniment (bottom). The darker the color, the larger the magnitude at a certain time-frequency point.

SONOGRAM

A sonogram, sonograph or spectogram is a wellknown spectrum display technique in speech processing and sound analyse, having been used for decades to analyse sounds and voices. A sonogram shows an overview of the spectrum of several seconds of sound. This enables the viewer to see general features such as the onset of notes or phonemes, formant peaks, and major transitions. A trained viewer can read the phonems in the sonogram. The sonogram representation has also been employed as an interface for spectrum editing and music analysis. The original sonogram was Backhaus`s(1932) system [Roa96], described earlier in the background section on spectrum analysis.

In the 1950s the Kay Sonograph [Roa96] was standard device for making sonograms. It consisted of a number of narrow bandpass analog filters and a recording system that printed dark bars on a roll of paper. The bars get thicker in proportion to the energy output from each filter. Today sonograms are implemented with the "Windows Fourier Transformation"[7]

REVIEW OF LITERATURE

REVIEW OF LITERATURE

A practical approach to the treatment of depression in patients with chronic kidney disease and end-stage renal disease

S Susan Hedayati, Venkata Yalamanchili and Fredric O Finkelstein

***Kidney International* 81, 247-255 (February (1) 2012)**

Depression is a common, under-recognized, and under-treated problem that is independently associated with increased morbidity and mortality in CKD patients. However, only a minority of CKD patients with depression are treated with antidepressant medications or nonpharmacologic therapy. Reasons for low treatment rates include a lack of properly controlled trials that support or refute efficacy and safety of various treatment regimens in CKD patients. The aim of this manuscript is to provide a comprehensive review of studies exploring depression treatment options in CKD. Observational studies as well as small trials suggest that certain serotonin-selective reuptake inhibitors may be safe to use in patients with advanced CKD and ESRD. These studies were limited by small sample sizes, lack of placebo control, and lack of formal assessment for depression diagnosis. Nonpharmacologic treatments were explored in selected ESRD samples. The most promising data were reported for frequent hemodialysis and cognitive behavioral therapy. Alternative proposed therapies include exercise training regimens, treatment of anxiety, and music therapy. Given the association of depression with cardiovascular events and mortality, and the excessive rates of cardiovascular death in CKD, it becomes imperative to not only investigate whether treatment of depression is efficacious, but also whether it would result in a reduction in morbidity and mortality in this patient population.

Effect of aromatherapy on pruritus relief in hemodialysis patients
Nahid Shahgholian, Mahlagha Dehghan, Mojgan Mortazavi, Farzaneh Gholami, and Mahboobeh Valiani,
Iran J Nurs Midwifery Res. 2010 Autumn; 15(4): 240–244.

Pruritus and skin dryness are currently the main cutaneous presentations of kidney disease patients undergoing hemodialysis. According to various studies, severe and obvious pruritus affects 15-49% of patients with chronic renal failure and 50-90% of patients under hemodialysis. The symptoms are more frequent in patients under hemodialysis than in those under peritoneal dialysis (42% vs. 32%). In Iran, a study has reported the prevalence of pruritus in 167 hemodialysis patients to be 41.9%, in which 37.1%, 11.4%, and 51.4% reported severe, moderate, and mild pruritus, respectively. In such patients, physical and mental ability as well as sleep quality are impaired by pruritus, hence the interference in life quality of the patient. Furthermore, an increase in mortality in patients with pruritus has been reported in some studies.

Since the physiopathology of pruritus in chronic renal failure patients is unknown and different hypotheses have been proposed in this respect, several treatments have been employed for pruritus relief, including intravenous lidocaine or heparin injection, oral administration of cholestyramine, active charcoal, low-protein diet, magnesium-free dialysis, electrical needle stimulation, parathyroidectomy, and UV treatment. Moreover, dialysis has slight effect on pruritus of such patients and kidney transplant is considered the definite treatment.

One of the treatments of the problem is complementary medicine. Such treatments have currently attracted great attention and many of them are used for patients with kidney diseases. Among these treatments, one can mention touch-therapy, consultation strategies, massage therapy, game therapy, and music therapy. Aromatherapy is also one of these complementary medicine methods increasingly used in the 21st century. Many of the effects of essential oils used in aromatherapy have been reported in animal experiments, including relaxation, anti-inflammation, analgesia, disinfection, anti-oxidation, and decreasing the blood urea level. Although there is an increasing inclination toward employing aromatherapy, the real effect of aromatherapy on uremic pruritus in patients with chronic kidney failure is not well established.

Moreover, the studies performed in other fields have reported controversial findings. For instance, in a study by Atashzadeh et al, the effect of perfume therapy and massage on pain intensity in multiple sclerosis patients in Tehran was investigated. It was demonstrated that both perfume therapy and massage had considerable effect on pain intensity and the effect of massaging with menthol (containing peppermint essence) was greater than that with sweet almond oil. On the other hand, a study by Pazandeh et al, on the effect of aromatherapy with chamomile on the pain of episiotomy showed that chamomile essence has no effect in reducing the episiotomy pain. Thus, the researcher performed this study to evaluate the effect of aromatherapy in relieving pruritus in patients undergoing hemodialysis in hospitals affiliated with Isfahan University of Medical Sciences in 2009. The objective of the study was to determine and compare pruritus scores before and after aromatherapy in the patients.

Listening to music decreases need for sedative medication during colonoscopy: a randomized, controlled trial

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Indian Journal of Gastroenterology 2006 Vol 25, pp 3-5

Music played during endoscopic procedures may alleviate anxiety and improve patient acceptance of the procedure. A prospective randomized, controlled trial was undertaken to determine whether music decreases the requirement for midazolam during colonoscopy and makes the procedure more comfortable and acceptable. **Methods:** Patients undergoing elective colonoscopy between October 2003 and February 2004 were randomized to either not listen to music (Group 1; n=40) or listen to music of their choice (Group 2; n=38) during the procedure. All patients received intravenous midazolam on demand in aliquots of 2 mg each. The dose of midazolam, duration of procedure, recovery time, pain and discomfort scores, and willingness to undergo a repeat procedure using the same sedation protocol were compared. **Results:** Patients in Group 2 received significantly less midazolam than those in Group 1 (p=0.007). The pain score was similar in the two groups, whereas discomfort score was lower in Group 2 (p=0.001). Patients in the two groups were equally likely to be willing for a repeat procedure. **Conclusion:** Listening to music during colonoscopy helps reduce the dose of sedative medications and decreases discomfort experienced during the procedure.

Does music exposure during chemotherapy improve quality of life in early breast cancer patients? A pilot study

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Med Sci Monit, 2006; 12(5): CR200-205

Adjuvant chemotherapy after surgery has been shown to improve survival in patients with early breast cancer. However, it has been well recognized that women receiving adjuvant chemotherapy experience a decline in quality of life. They report deterioration of cognitive function and fatigue as well as toxicities such as nausea and vomiting, alopecia, and menopausal symptoms. Although it has been shown that some interventions, such as exercise, improve quality of life, many women still suffer from chemotherapy toxicities. Music as a way of complementary intervention has been shown to improve quality of life of cancer patients with terminal disease. In addition, it has also been shown to decrease nausea and vomiting in a heterogeneous cancer population. Therefore, in this study we wanted to test whether brief music exposure during chemotherapy administration would impede the decline in quality of life in breast cancer patients receiving adjuvant chemotherapy.

A PERIODICITY-BASED THEORY FOR HARMONY PERCEPTION AND SCALES

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Empirical results demonstrate, that human subjects rate harmonies, e.g. major and minor triads, differently with respect to their sonority. These judgements of listeners have a strong psychophysical basis. Therefore, harmony perception often is explained by the notions of dissonance and tension, computing the consonance of one or two intervals. In this paper, a theory on harmony perception based on the notion of periodicity is introduced. Mathematically, periodicity is derivable from the frequency ratios of the tones in the chord with respect to its lowest tone. The used ratios can be computed by continued fraction expansion and are psychophysically motivated by the just noticeable differences in pitch perception. The theoretical results presented here correlate well to experimental results and also explain the origin of complex chords and common musical scales.

Combining Pitch-Based Inference and Non-Negative Spectrogram Factorization in Separating Vocals from Polyphonic Music

Tuomas Virtanen, Annamaria Mesaros, Matti Ryynänen
Department of Signal Processing, Tampere University of Technology, Finland

This paper proposes a novel algorithm for separating vocals from polyphonic music accompaniment. Based on pitch estimation, the method first creates a binary mask indicating timefrequency segments in the magnitude spectrogram where harmonic content of the vocal signal is present. Second, nonnegative matrix factorization (NMF) is applied on the non-vocal segments of the spectrogram in order to learn a model for the accompaniment. NMF predicts the amount of noise in the vocal segments, which allows separating vocals and noise even when they overlap in time and frequency. Simulations with commercial and synthesized acoustic material show an average improvement of 1.3 dB and 1.8 dB, respectively, in comparison with a reference algorithm based on sinusoidal modeling, and also the perceptual quality of the separated vocals is clearly improved. The method was also tested in aligning separated vocals and textual lyrics, where it produced better results than the reference method.

Sonogram
Acoustical Frequency Analysis Tool
Christoph Lauer

Sonogram transformates time-domain based audio information (samples) into the frequency domain using the transformation methods of "Fast Fourier Transformation" (FFT), "Linear Prediction Coe_cients" (LPC), "Cepstral Analysis" and the "Wavelet transformation". It extracts samples from multimedia files and daws them into the main window which shows the frequency information in a two-dimensional form (frequency-time area). The most common audio and video file formats are supported. The two-dimensional plots can be shown in an interactive three-dimensional representation. Many signal analysis parameters can be configured and the representation can be configured in different forms. The program is written in Java2 therefore it runs on any operating system where Java2, is supported. Calculated pictures can be stored as \Scalable Vector Graphics" (SVG) and bitmaps. It has a build-in documentation which describe most of software components. The program can be free used for non commercial and research purposes.

SPECTROGRAM BASED FEATURES SELECTION USING MULTIPLE KERNEL LEARNING FOR SPEECH/MUSIC DISCRIMINATION

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This paper presents a multiple kernel learning (MKL) approachto speech/music discrimination (SMD). The timefrequency representation (spectrogram) implemented by short-time Fourier transform (STFT) of audio segment is decomposed by wavelet packet transform into different subband levels. The subbands, which contain rich texture information, are used as features for this discrimination problem. MKL technique is used to select the optimal subbands to discriminate the audio signals. The proposed MKL based algorithm is applied for SMD of a standard dataset. The experimental results show that the proposed technique yields noticeable improvements in classification accuracy and tolerance toward different noise types compared to the existing methods.

A STATISTICAL APPROACH TO MUSICAL GENRE CLASSIFICATION USING NON-NEGATIVE MATRIX FACTORIZATION

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This paper introduces a new feature set based on a Non-negative Matrix Factorization approach for the classification of musical signals into genres, only using synchronous organization of music events (vertical dimension of music). This feature set generates a vector space to describe the spectrogram representation of a music signal.
The space is modeled statistically by a mixture of Gaussians (GMM). A new signal is classified by considering the likelihoods over all the estimated feature vectors given these statistical models, without constructing a model for the signal itself. Cross-validation tests on two commonly utilized datasets for this task show the superiority of the proposed features compared to the widely used MFCC type of representation based on classification accuracies (over 9% of improvement), as well as on a stability measure introduced in this paper for GMM.

Music Genre Recognition Using Spectrograms

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In this paper we present an alternative approach for music genre classification which converts the audio signal into spectrograms and then extracts features from this visual representation. The idea is that treating the time-frequency representation as a texture image we can extract features to build reliable music genre classification systems. The proposed approach also takes into account a zoning mechanism to perform local feature extraction, which has been proved to be quite efficient. On a very challenging dataset of 900 music pieces divided among 10 music genres, we have demonstrated that the classifier trained with texture compares similarly to the literature. Besides, when it was combined with other classifiers trained with short-term, low-level characteristics of the music audio signal we got an improvement of about 7 percentage points in the recognition rate.

AIMS & OBJECTIVES

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- Implementation of Carnatic and Hindustani Music as the Complementary Medicine in Music Therapy
- Analytical evidence of the tracks
- Analysis of the effect of music tracks in CKD and RA patients
- Statistical Interpretation of the results

MATERIALS & METHODS

MATERIALS AND METHODS

1. Identification of Ragas of the musical tracks used for therapy

The ragas of the tracks used for the musical therapy was identified based on their swara sthanas by Dr. Rukmini Srivatsan, Ragasudha School of Music

2. Identification of Waveform, Intensity, Sprectrogram, pitch and duration of the musical tracks used for therapy

Analysis of the tracks were performed using Phonetics Analyses

Software is a very flexible tool to do speech analysis. It offers a wide range of standard and non-standard procedures, including spectrographic analysis, articulatory synthesis, and neural networks.

The following analysis has been carried out:

1. Finding information in the Manual
2. Create a speech object
3. Process a signal
4. Label a waveform
5. General analysis (waveform, intensity, sonogram, pitch, duration)
6. Spectrographic analysis
7. Intensity analysis
8. Pitch analysis
9. Using Long Sound files

3. Clinical Trials on patients for a span of 1 month for 30 patients

Fig.13: Dialysis unit used for this study

Fig.14: Patient under Music Therapy (MT)

The CKD patients undergoing hemolytic dialysis were chosen for our study. Around 30 hyperglycemic with RA complaint patients were chosen for our trials and they were treated with the musical therapy for an hour during dialysis at Dialysis Unit, Vasavi Healthcare, Bangalore. Pre-Blood pressure and Post Blood pressure was recorded before and after dialysis every day for a period of one month.

RESULTS

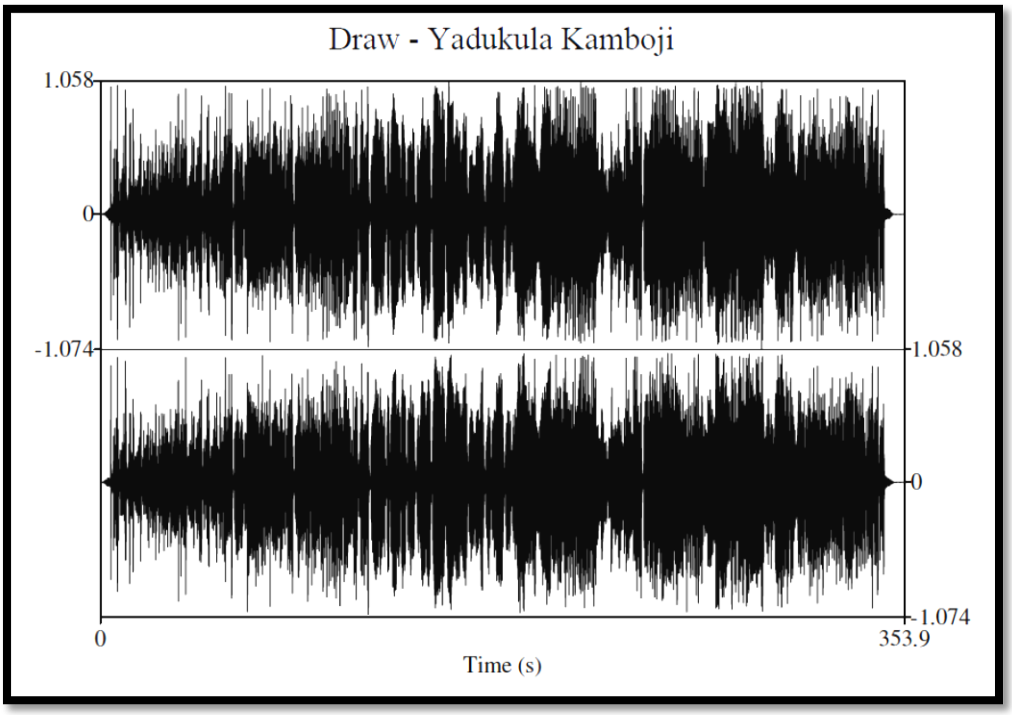
RESULTS

I. Identification of Ragas of the musical tracks used for therapy

1. Track 1 – Raga: Yadukula Kamboji; 28th mela janya of Harikamboji
2. Track 2 – Raga: Charukeshi
3. Track 3 – Raga: Kapi
4. Track 4 – Raga: Bilahari
5. Track 5 – Raga: Kanaada
6. Track 6 – Raga: Senchurutti
7. Track 7 – Raga: Brindhavani
8. Track 8 – Raga: Mohana or Bhoop
9. Track 9 – Raga: Dharbari Kanaada

II. Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Yadukula Kamboji Ragam (Track 1)

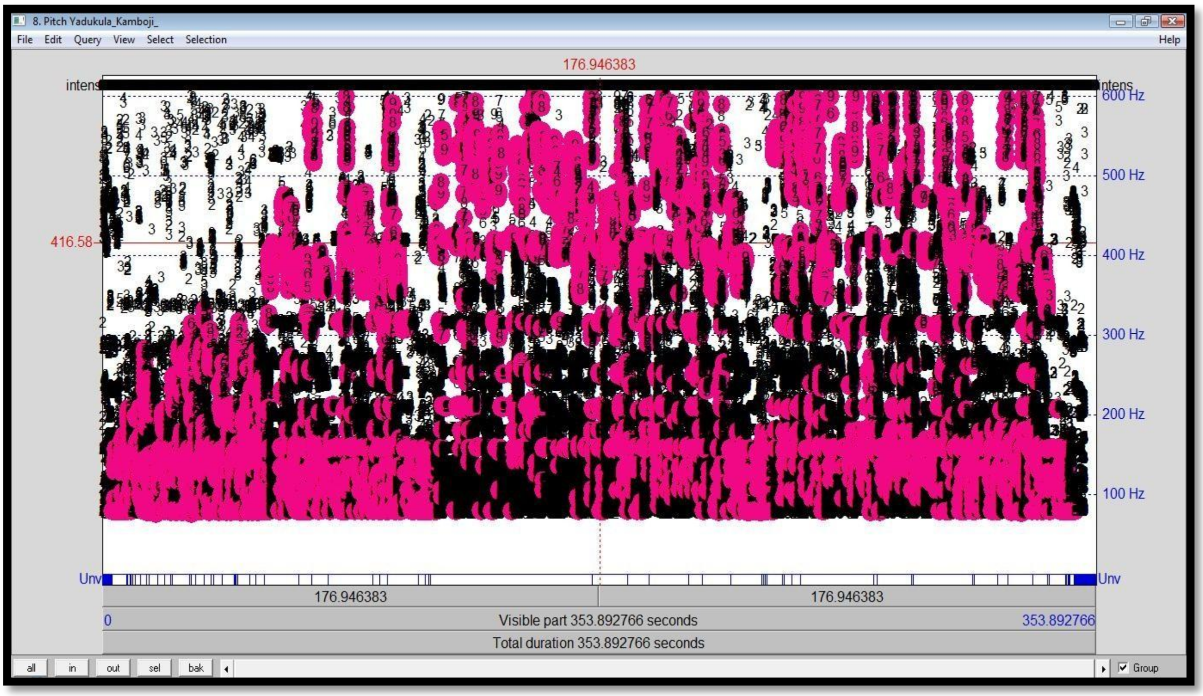
1. Draw



2. Query

- Total Duration: 353.8927664399093 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 15606671 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: -7.699997912704877e-005 Pascal
- Time of Minimum (Interpolation at Sinc70): 291.0425176386405 seconds
- Time of Maximum (Interpolation at Sinc70): 291.04059248740305 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.1004909799095826 Pascal
- Nearest zero crossing: 0.4999734231989989 seconds
- Mean: -9.851586982466359e-005 Pascal
- Root mean square: 0.18842128794976648 Pascal
- Standard Deviation: 0.18842126820410185 Pascal
- Energy: 12.564106872203933 Pa2 sec
- Power: 0.03550258175264882 Pa2
- Energy in Air: 0.031410267180509835 Joule/m2
- Power in Air: 8.875645438162204e-005 Watt/m2
- Intensity: 79.4819994483022 dB

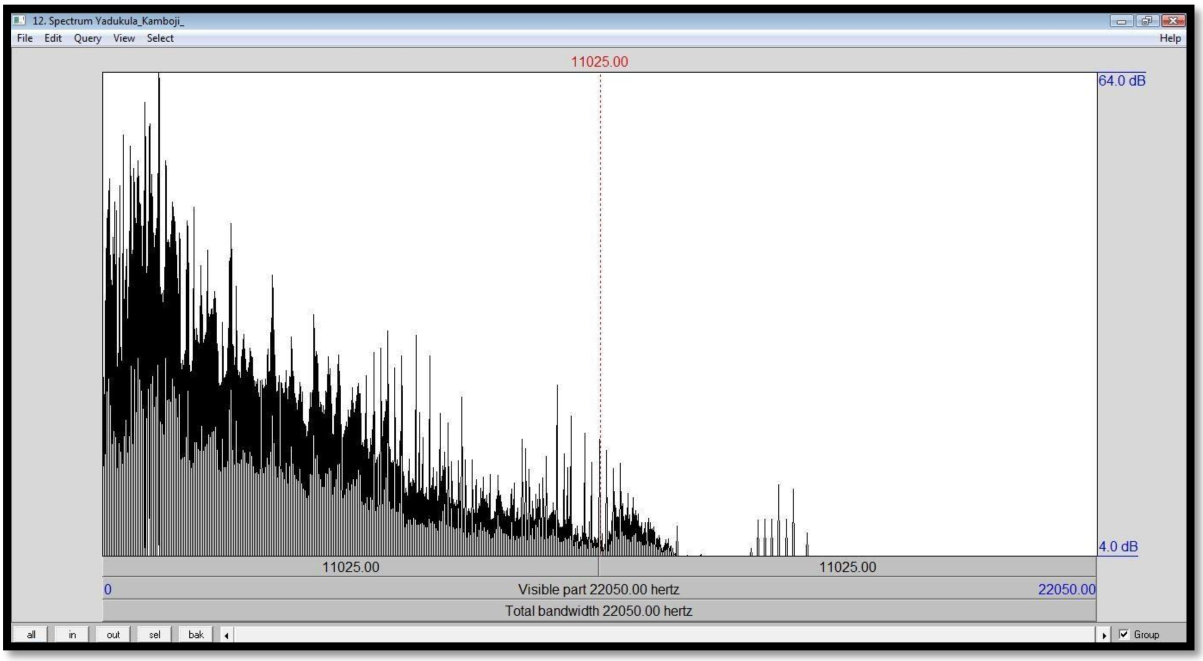
3. Periodicity



- Object type: Pitch
- Object name: Yadukula_Kamboji
- **Time domain:**
- Start time: 0 seconds
- End time: 353.8927664399093 seconds
- Total duration: 353.8927664399093 seconds
- Time sampling:
- Number of frames: 35386 (32141 voiced)
- Time step: 0.01 seconds
- First frame centred at: 0.02138321995463657 seconds
- Ceiling at: 600 Hz
- **Estimated quantiles:**
- 10% = 78.7335608 Hz = 73.5841134 Mel = -4.13939241 semitones above 100 Hz = 2.43542571 ERB
- 16% = 104.440055 Hz = 95.6239428 Mel = 0.752101489 semitones above 100 Hz = 3.12770167 ERB
- 50% = 175.141883 Hz = 152.046982 Mel = 9.70228957 semitones above 100 Hz = 4.82601211 ERB
- 84% = 430.619144 Hz = 318.046231 Mel = 25.2769495 semitones above 100 Hz = 9.34512835 ERB
- 90% = 476.066025 Hz = 342.963004 Mel = 27.0139401 semitones above 100 Hz = 9.97506558 ERB
- **Estimated spreading:**
- 84%-median = 255.5 Hz = 166 Mel = 15.57 semitones = 4.519 ERB
- median-16% = 70.7 Hz = 56.42 Mel = 8.95 semitones = 1.698 ERB
- 90%-10% = 397.3 Hz = 269.4 Mel = 31.15 semitones = 7.54 ERB
- Minimum 75.3284669 Hz = 70.5973293 Mel = -4.90479512 semitones above 100 Hz = 2.3402342 ERB
- Maximum 599.913428 Hz = 405.638013 Mel = 31.0170519 semitones above 100 Hz = 11.5145699 ERB
- Range 524.6 Hz = 335.040684 Mel = 35.92 semitones = 9.174 ERB
- Average: 253.577178 Hz = 198.969891 Mel = 12.7526927 semitones above 100 Hz = 6.04394033 ERB

- Standard deviation: 153 Hz = 101.5 Mel = 10.98 semitones = 2.811 ERB
- Mean absolute slope: 736.5 Hz/s = 498.8 Mel/s = 57.91 semitones/s = 13.98 ERB/s
- Mean absolute slope without octave jumps: 26.9 semitones/s

4. Spectrum



Data type: Spectrum

Data name: Yadukula_Kamboji

Editor start: 0 hertz

Editor end: 22050 hertz

Window start: 0 hertz

Window end: 22050 hertz

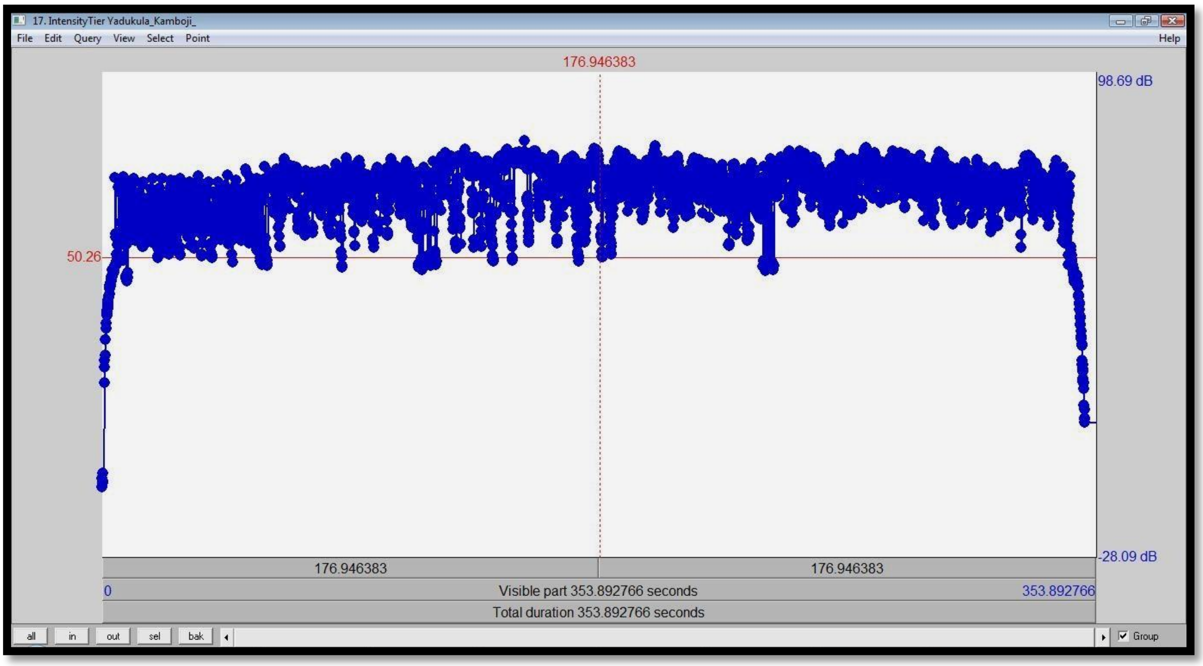
Selection start: 11025 hertz

Selection end: 11025 hertz

Arrow scroll step: 100 hertz

Group: yes

5. Intensity



Editor name: 17. IntensityTier Yadukula_Kamboji

Data type: IntensityTier (Peaks)

Data name: Yadukula_Kamboji

Editor start: 0 seconds

Editor end: 353.8927664399093 seconds

Window start: 0 seconds

Window end: 353.8927664399093 seconds

Selection start: 176.94638321995464 seconds

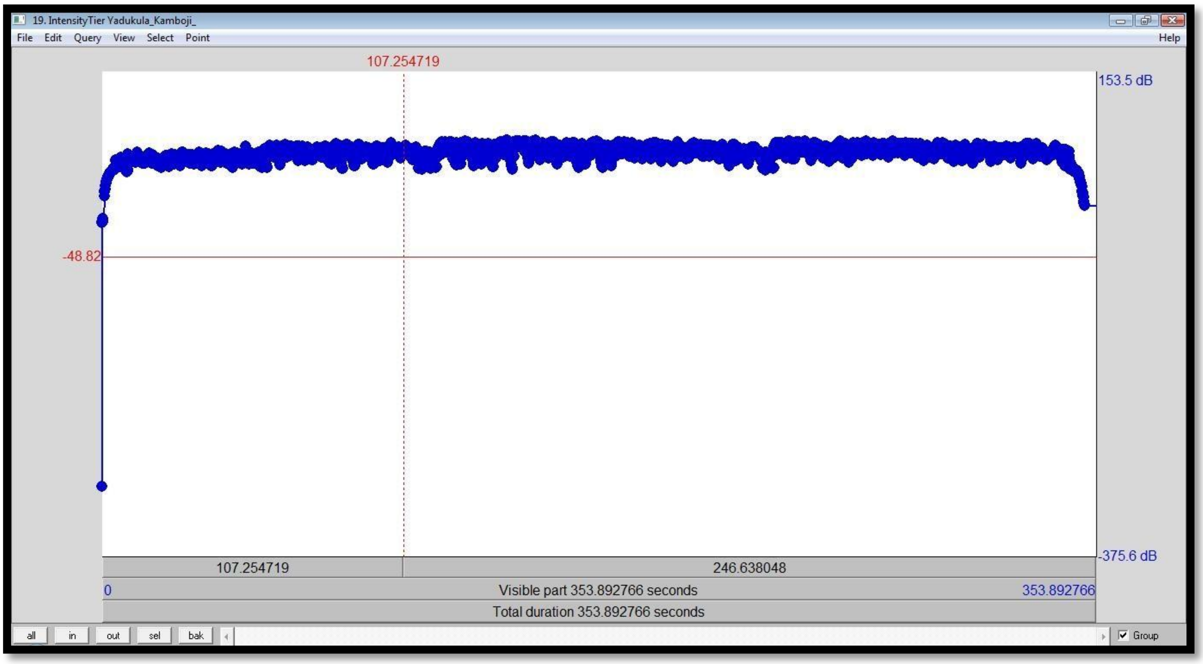
Selection end: 176.94638321995464 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Intensity Tier (Valleys)



Object type: Intensity Tier (Valleys)

Object name: Yadukula_Kamboji

Domain:

xmin: 0

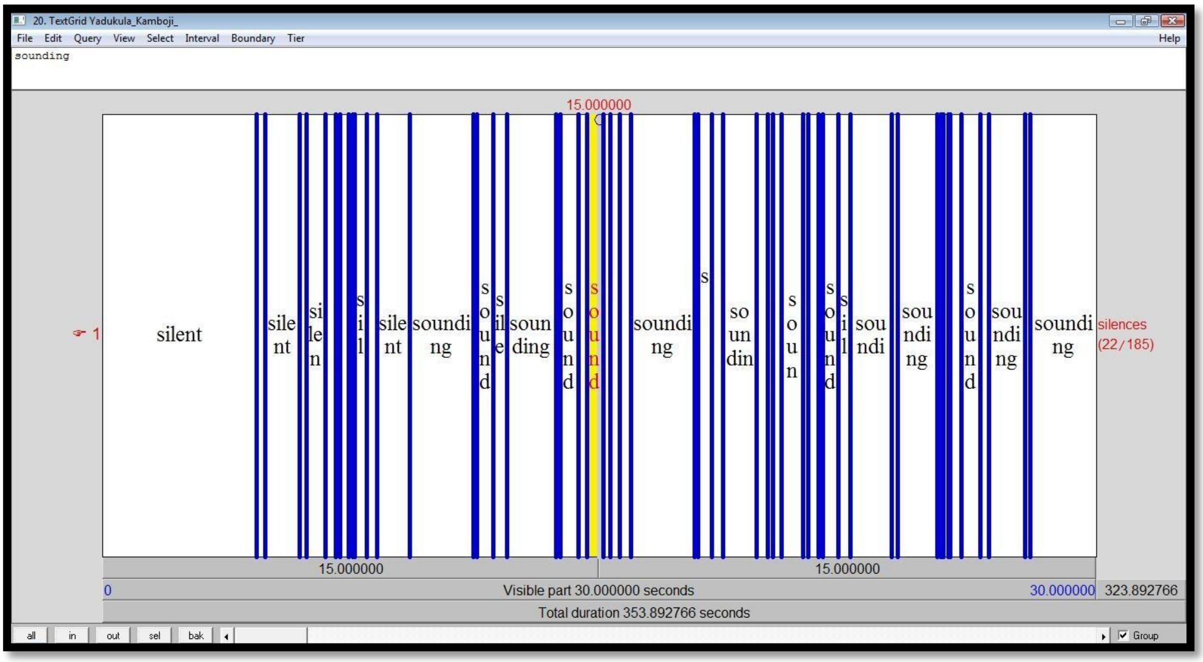
xmax: 353.8927664399093

Number of points: 5251

Minimum value: -300

Maximum value: 77.90577873412497

TextGrid (Silences)



Object type: TextGrid (Silences)

Object name: Yadukula_Kamboji

Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 185

Number of points: 0

6. Manipulation

Object type: Manipulation

Object name: Yadukula_Kamboji

Domain:

xmin: 0

xmax: 353.8927664399093

Editor type: ManipulationEditor

Editor name: 21. Manipulation Yadukula_Kamboji

Data type: Manipulation

Data name: Yadukula_Kamboji

Editor start: 0 seconds

Editor end: 353.8927664399093 seconds

Window start: 0 seconds

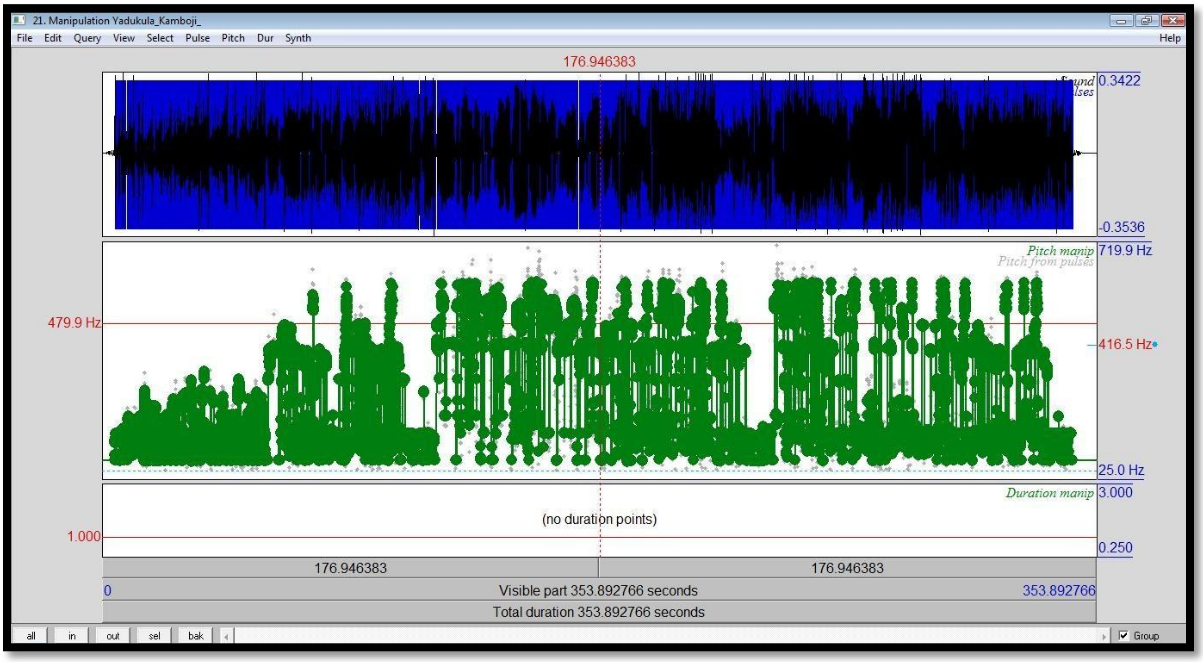
Window end: 353.8927664399093 seconds

Selection start: 176.94638321995464 seconds

Selection end: 176.94638321995464 seconds

Arrow scroll step: 0.05 seconds

Group: yes



7. Pitch Tier

Object type: PitchTier

Object name: Yadukula_Kamboji_

Time domain:

Start time: 0 seconds

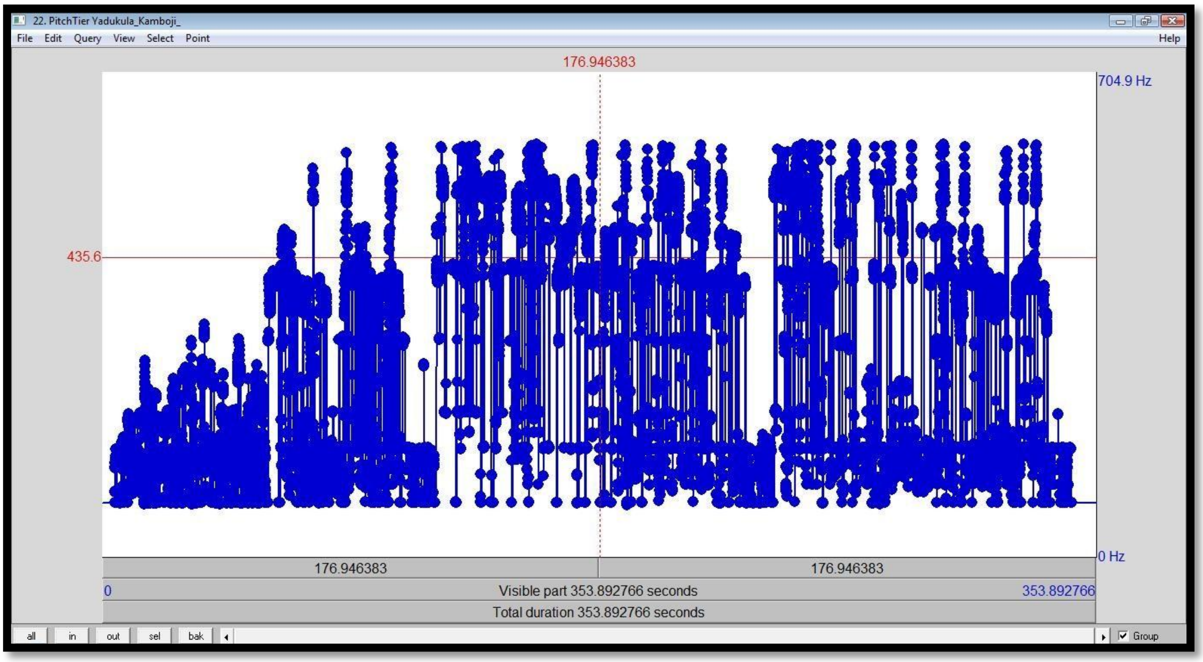
End time: 353.8927664399093 seconds

Total duration: 353.8927664399093 seconds

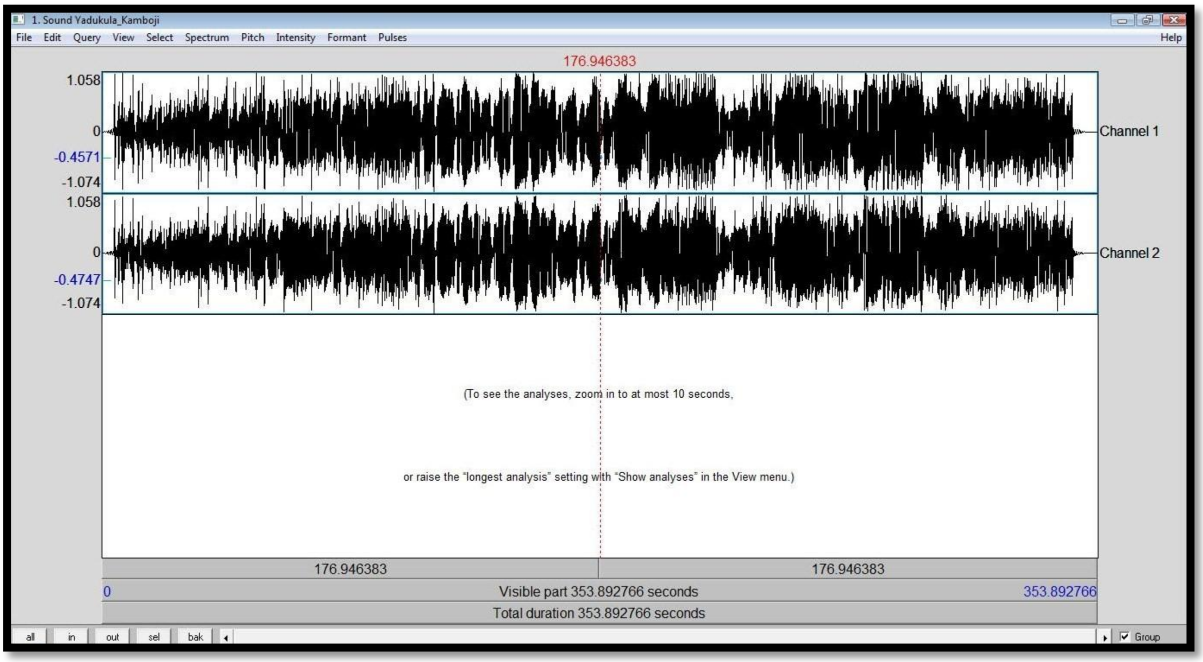
Number of points: 31689

Minimum pitch value: 75.01023591226118 Hz

Maximum pitch value: 599.8808357271182 Hz



8. Visible Sound



Data type: Sound

Data name: Yadukula_Kamboji

Editor start: 0 seconds

Editor end: 353.8927664399093 seconds

Window start: 0 seconds

Window end: 353.8927664399093 seconds
Selection start: 176.94638321995464 seconds
Selection end: 176.94638321995464 seconds
Arrow scroll step: 0.05 seconds
Group: yes
Sound scaling strategy: by window
Spectrogram show: yes
Spectrogram view from: 0 Hz
Spectrogram view to: 5000 Hz
Spectrogram window length: 0.005 seconds
Spectrogram dynamic range: 70 dB
Spectrogram number of time steps: 1000
Spectrogram number of frequency steps: 250
Spectrogram method: Fourier
Spectrogram window shape: Gaussian
Spectrogram autoscaling: yes
Spectrogram maximum: 100 dB/Hz
Spectrogram pre-emphasis: 6 dB/octave
Spectrogram dynamic Compression: 0
Spectrogram cursor frequency: 0 Hz
Pitch show: yes
Pitch floor: 75 Hz
Pitch ceiling: 500 Hz
Pitch unit: Hertz
Pitch drawing method: automatic
Pitch view from: 0 Hertz
Pitch view to: 0 Hertz
Pitch method: autocorrelation
Pitch very accurate: no
Pitch max. number of candidates: 15
Pitch silence threshold: 0.03 of global peak
Pitch voicing threshold: 0.45 (periodic power / total power)
Pitch octave cost: 0.01 per octave
Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Object type: Sound

Object name: Yadukula_Kamboji

Number of channels: 2 (stereo)

Time domain:

  Start time: 0 seconds

  End time: 353.8927664399093 seconds

  Total duration: 353.8927664399093 seconds

Time sampling:

  Number of samples: 15606671

  Sampling period: 2.2675736961451248e-005 seconds

  Sampling frequency: 44100 Hz

  First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

  Minimum: -1.07362045 Pascal

  Maximum: 1.05769212 Pascal

  Mean: -9.85158698e-005 Pascal

Root-mean-square: 0.188421288 Pascal

Total energy: 12.5641069 Pascal² sec (energy in air: 0.0314102672 Joule/m²)

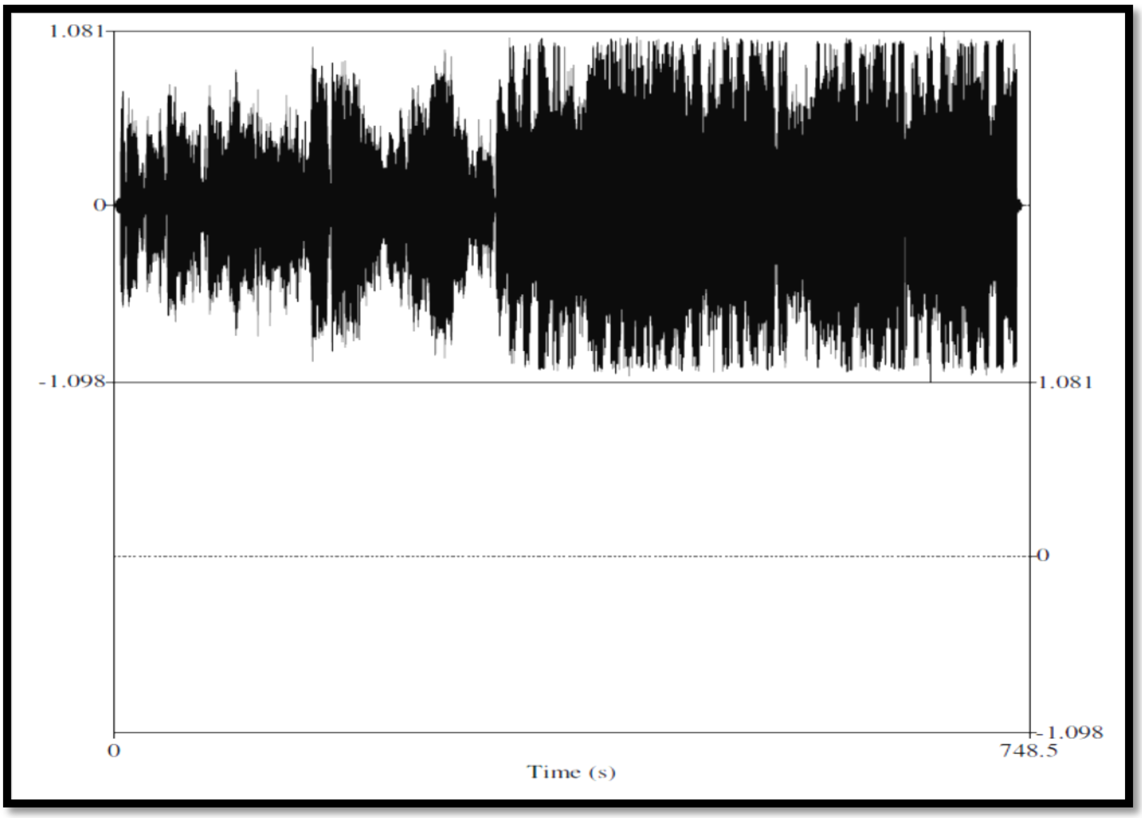
Mean power (intensity) in air: 8.87564544e-005 Watt/m² = 79.48 dB

Standard deviation in channel 1: 0.190932769 Pascal

Standard deviation in channel 2: 0.185875836 Pascal

II. Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Charukesi (Track 2)

1. Draw



Object type: Sound

Object name: Charukesi

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 748.5246031746032 seconds

Total duration: 748.5246031746032 seconds

Time sampling:

Number of samples: 33009935

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.09845686 Pascal

Maximum: 1.08111195 Pascal

Mean: -9.54200091e-005 Pascal

Root-mean-square: 0.184582675 Pascal

Total energy: 25.5028052 Pascal² sec (energy in air: 0.0637570129 Joule/m²)

Mean power (intensity) in air: 8.51769102e-005 Watt/m² = 79.3 dB

Standard deviation in channel 1: 0.186457386 Pascal

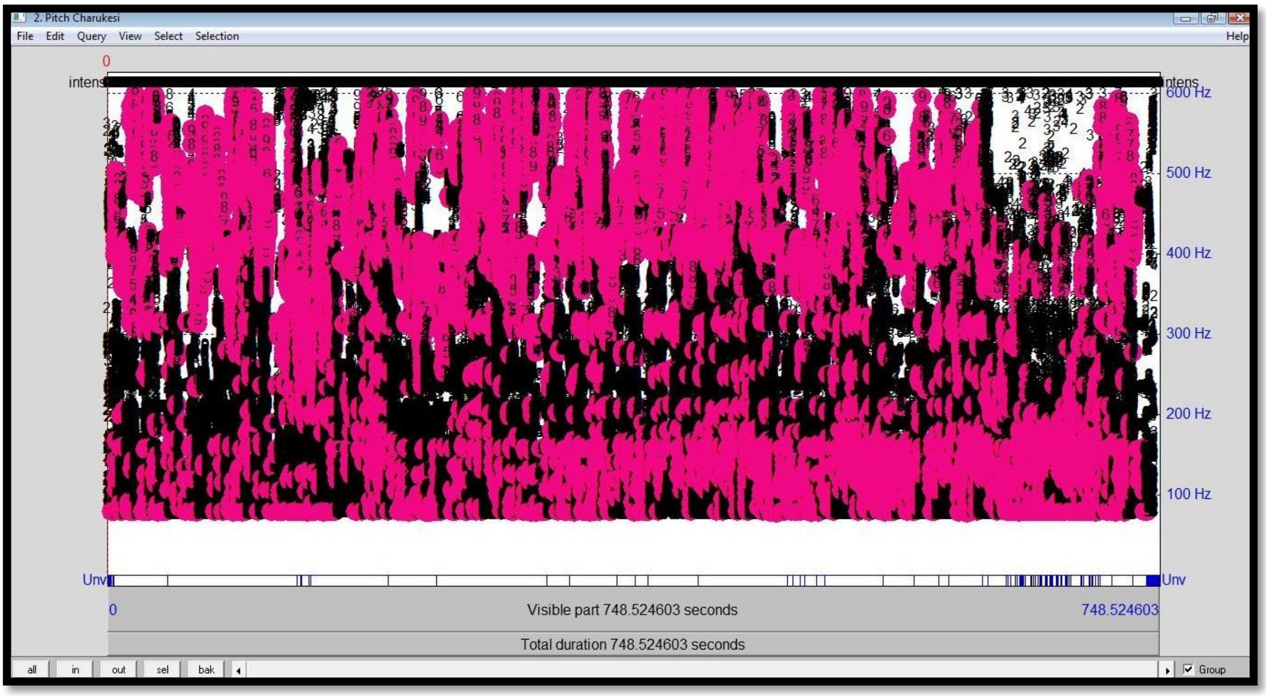
Standard deviation in channel 2: 0.182688684 Pascal

2. Query

- Total Duration: 748.5246031746032 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 33009935 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 0.0022562358276643994 seconds
- Sound Value at time: 22050.5
- Time of Minimum (Interpolation at Sinc70): 667.9786561466661 seconds
- Time of Maximum (Interpolation at Sinc70): 678.8089055797727 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.1041327717059566 Pascal
- Nearest zero crossing: 0.499846694243264 seconds
- Mean: -9.542000909554423e-005 Pascal
- Root mean square: 0.18458267546916257 Pascal
- Standard Deviation: 0.18458265347268785 Pascal
- Energy: 25.502805165348217 Pa2 sec

- Power: 0.03407076408335419 Pa2
- Energy in Air: 0.06375701291337055 Joule/m2
- Power in Air: 8.517691020838548e-005 Watt/m2
- Intensity: 79.30321881995226 dB

3. Periodicity



Object type: Pitch

Object name: Charukesi

Time domain:

Start time: 0 seconds

End time: 748.5246031746032 seconds

Total duration: 748.5246031746032 seconds

Time sampling:

Number of frames: 74849 (68276 voiced)

Time step: 0.01 seconds

First frame centred at: 0.022301587301571026 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 83.2082963 Hz = 77.4846335 Mel = -3.18240859 semitones above 100 Hz =

2.55923303 ERB

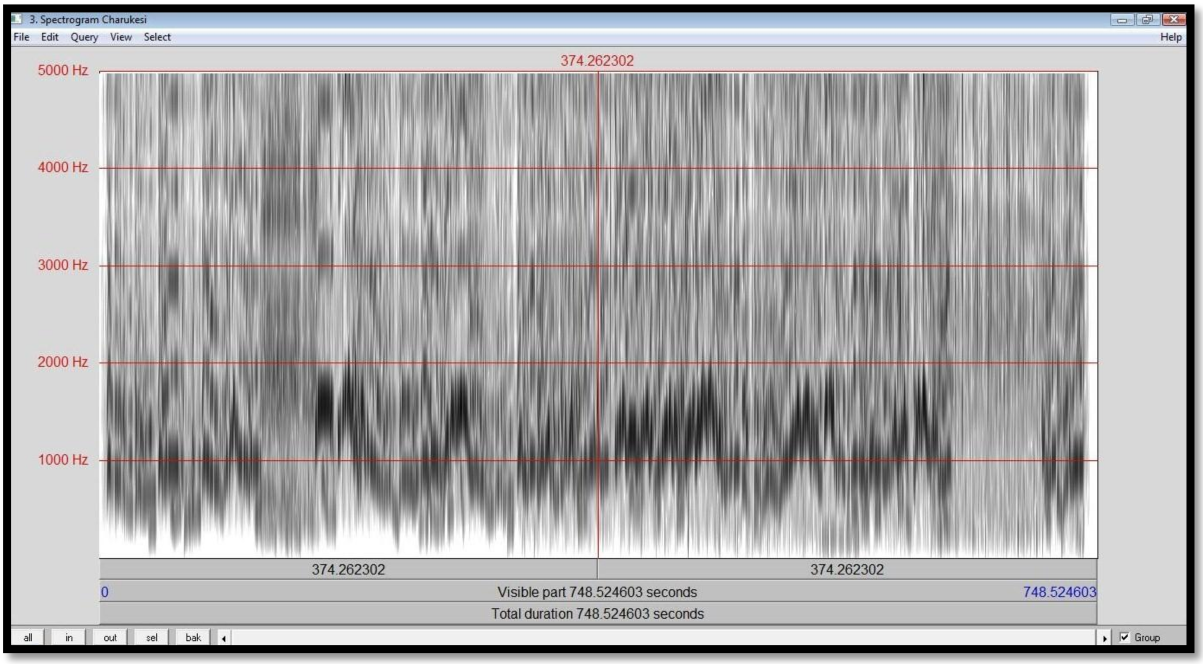
16% = 117.248168 Hz = 106.28407 Mel = 2.75478452 semitones above 100 Hz = 3.45639854 ERB
50% = 316.41129 Hz = 249.942796 Mel = 19.9416129 semitones above 100 Hz = 7.56461222 ERB
84% = 482.335494 Hz = 346.313388 Mel = 27.2404437 semitones above 100 Hz = 10.0589574 ERB
90% = 503.255492 Hz = 357.34756 Mel = 27.9754921 semitones above 100 Hz = 10.3339277 ERB

Estimated spreading:

84%-median = 165.9 Hz = 96.37 Mel = 7.299 semitones = 2.494 ERB
median-16% = 199.2 Hz = 143.7 Mel = 17.19 semitones = 4.108 ERB
90%-10% = 420.1 Hz = 279.9 Mel = 31.16 semitones = 7.775 ERB

Minimum 75.8117318 Hz = 71.0222148 Mel = -4.79408368 semitones above 100 Hz = 2.35379635 ERB
Maximum 599.966691 Hz = 405.663488 Mel = 31.0185889 semitones above 100 Hz = 11.5151834 ERB
Range 524.2 Hz = 334.641273 Mel = 35.81 semitones = 9.161 ERB
Average: 306.692261 Hz = 233.651638 Mel = 16.2011534 semitones above 100 Hz = 6.99406056 ERB
Standard deviation: 161.3 Hz = 106.2 Mel = 11.36 semitones = 2.933 ERB
Mean absolute slope: 766.3 Hz/s = 504.6 Mel/s = 55.23 semitones/s = 13.96 ERB/s
Mean absolute slope without octave jumps: 22.43 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Charukesi

Time domain:

Start time: 0 seconds

End time: 748.5246031746032 seconds

Total duration: 748.5246031746032 seconds

Time sampling:

Number of time slices (frames): 374258

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.00530158730158719 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

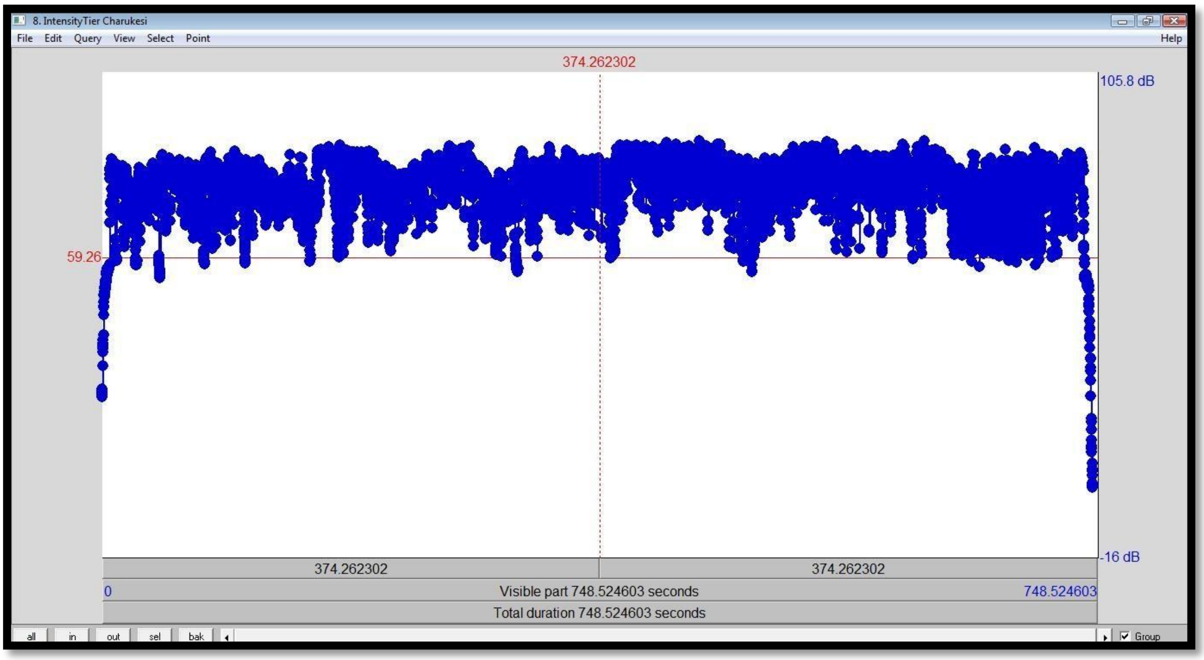
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peaks)

Object name: Charukesi

Domain:

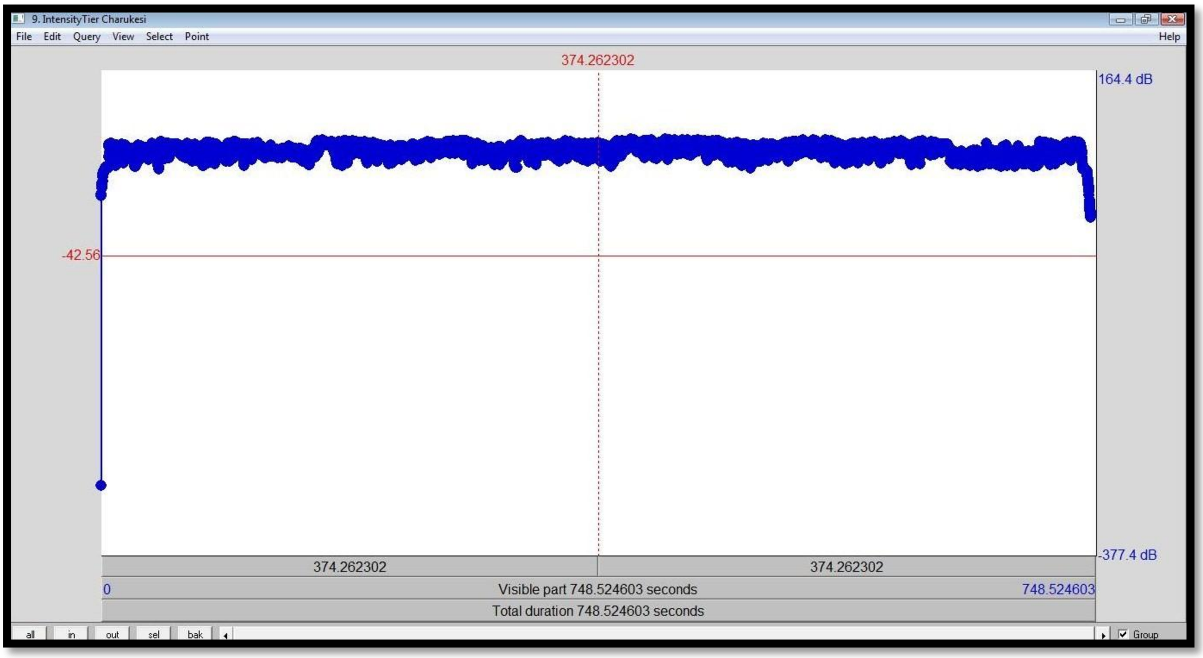
xmin: 0

xmax: 748.5246031746032

Number of points: 11964

Minimum value: 1.3943005635049586

Maximum value: 88.37682698278492



Object type: IntensityTier (Valleys)

Object name: Charukesi

Domain:

xmin: 0

xmax: 748.5246031746032

Number of points: 11964

Minimum value: -300

Maximum value: 87.00485148214591

Object type: TextGrid (Silences)

Object name: Charukesi

Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 229

Number of points: 0

6. Manipulation

Object type: Manipulation

Object name: Charukesi

Domain:

  xmin: 0

  xmax: 748.5246031746032

Editor type: ManipulationEditor

Editor name: 13. Manipulation Charukesi

Data type: Manipulation

Data name: Charukesi

Editor start: 0 seconds

Editor end: 748.5246031746032 seconds

Window start: 0 seconds

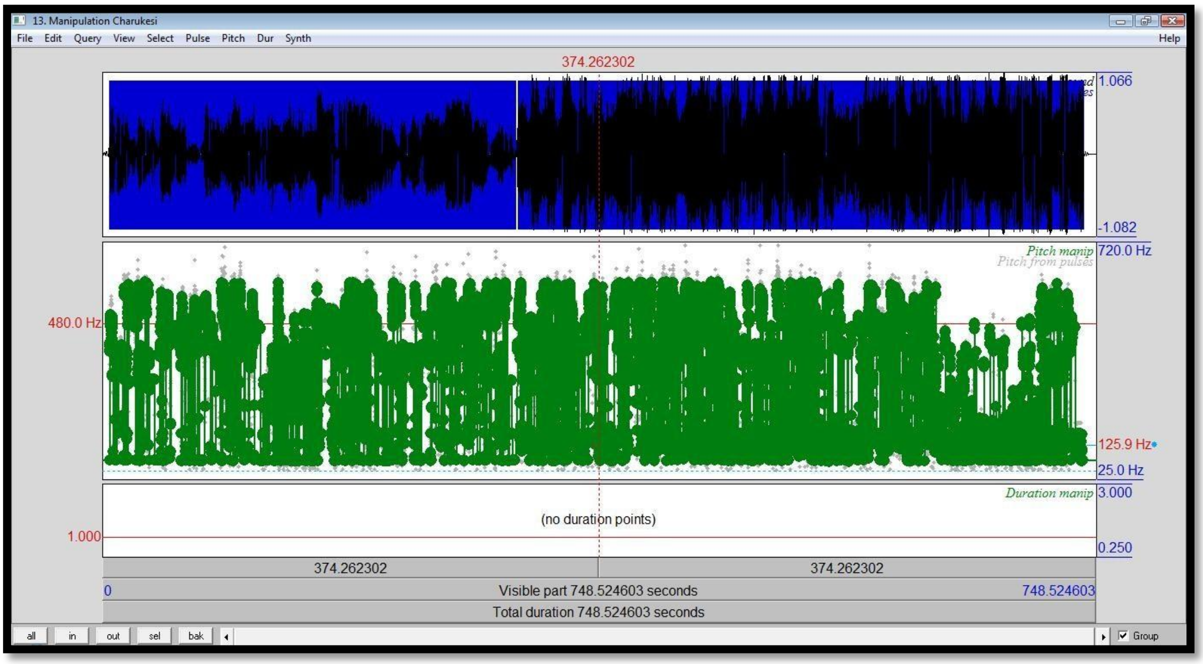
Window end: 748.5246031746032 seconds

Selection start: 374.2623015873016 seconds

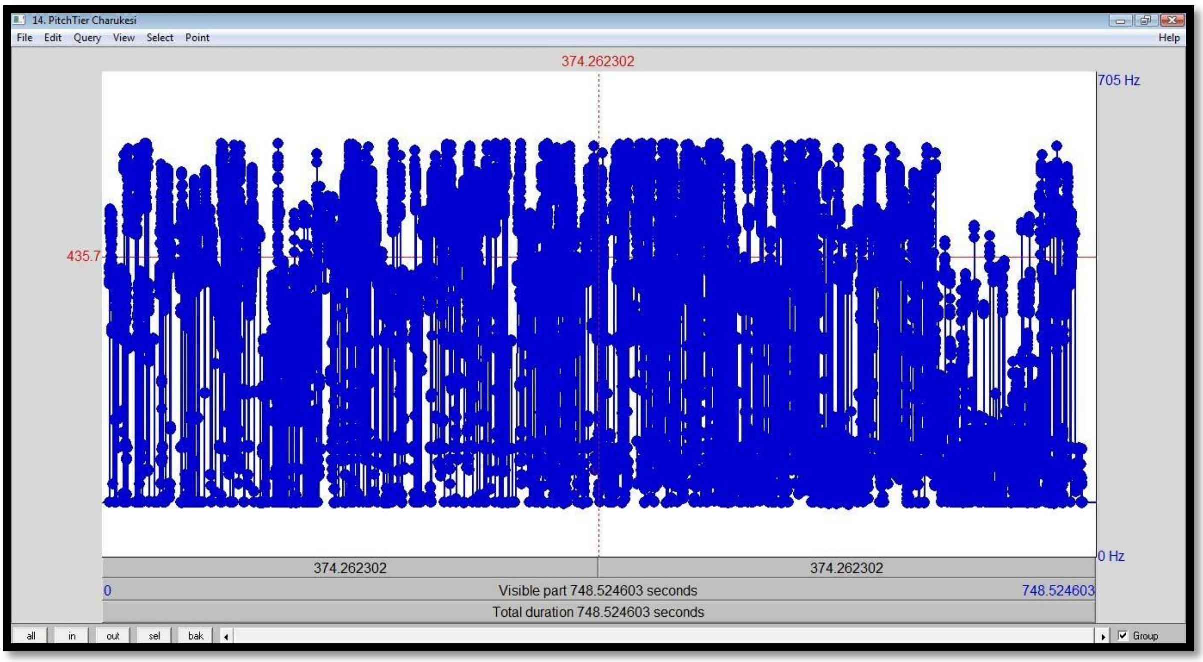
Selection end: 374.2623015873016 seconds

Arrow scroll step: 0.05 seconds

Group: yes



7. Pitch Tier



Editor type: PitchTierEditor

Editor name: 14. PitchTier Charukesi

Data type: PitchTier

Data name: Charukesi

Editor start: 0 seconds

Editor end: 748.5246031746032 seconds

Window start: 0 seconds

Window end: 748.5246031746032 seconds

Selection start: 374.2623015873016 seconds

Selection end: 374.2623015873016 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Object type: PitchTier

Object name: Charukesi

Time domain:

Start time: 0 seconds

End time: 748.5246031746032 seconds

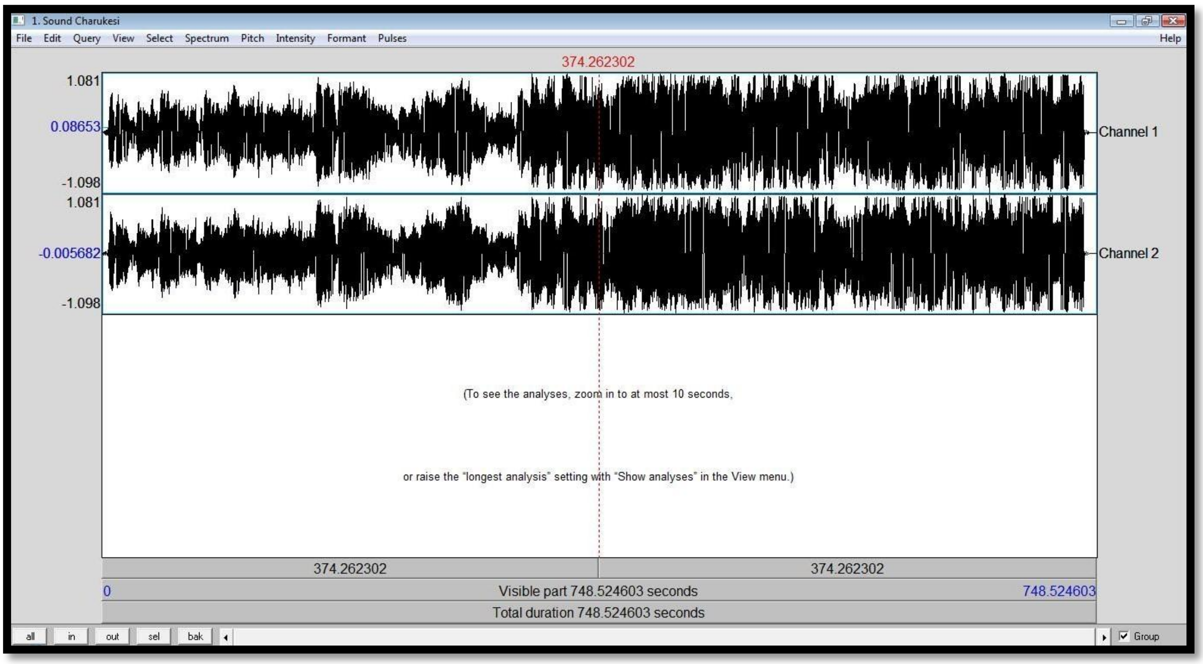
Total duration: 748.5246031746032 seconds

Number of points: 67249

Minimum pitch value: 75.17733094046491 Hz

Maximum pitch value: 599.9925392114391 Hz

8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Charukesi

Data type: Sound

Data name: Charukesi

Editor start: 0 seconds

Editor end: 748.5246031746032 seconds

Window start: 0 seconds

Window end: 748.5246031746032 seconds

Selection start: 374.2623015873016 seconds

Selection end: 374.2623015873016 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

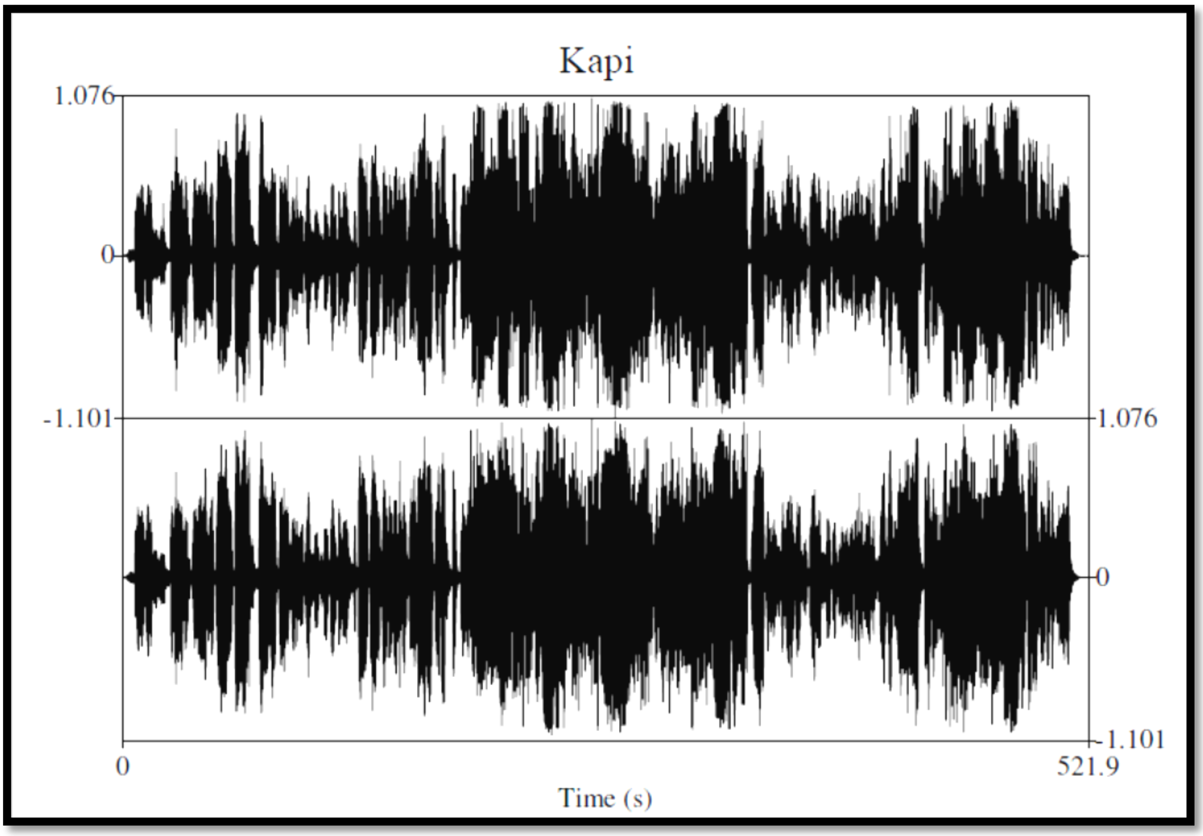
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of the musical of Kapi ragam (Track 3)

1. Sound Draw



Object type: Sound

Object name: Kapi

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 521.8862358276645 seconds

Total duration: 521.8862358276645 seconds

Time sampling:

Number of samples: 23015183

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.10119893 Pascal

Maximum: 1.076018 Pascal

Mean: -0.000108365506 Pascal

Root-mean-square: 0.180846863 Pascal

Total energy: 17.0685962 Pascal² sec (energy in air: 0.0426714904 Joule/m²)

Mean power (intensity) in air: 8.17639698e-005 Watt/m² = 79.13 dB

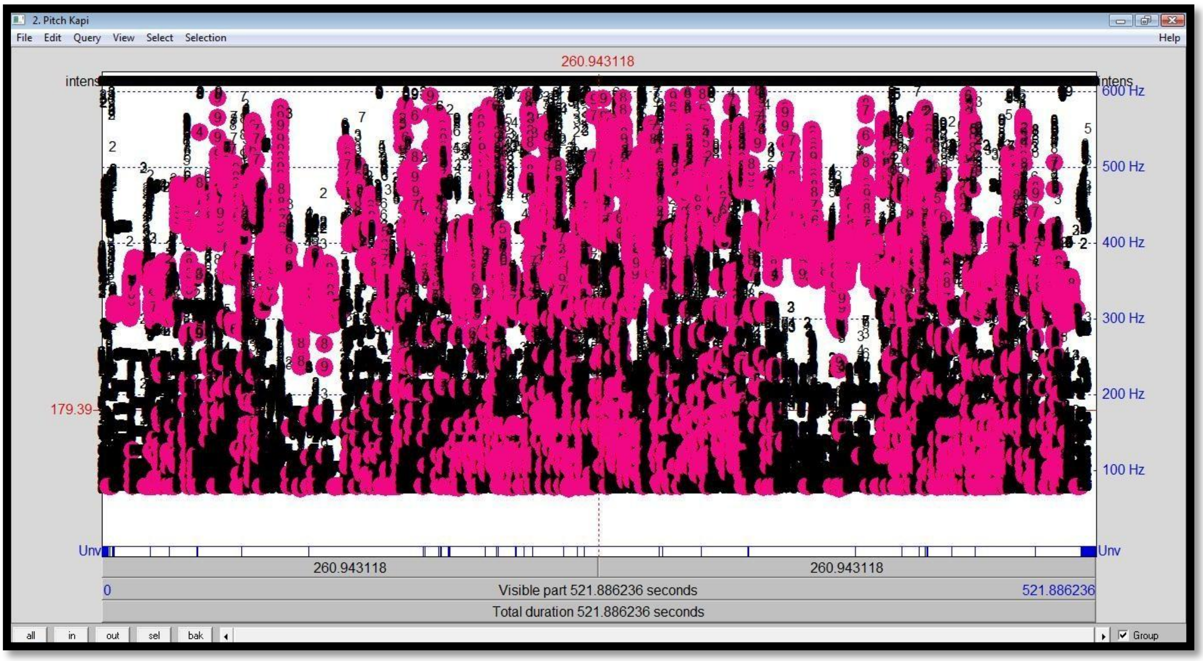
Standard deviation in channel 1: 0.180998914 Pascal

Standard deviation in channel 2: 0.180694627 Pascal

2. Query

- Total Duration: 521.8862358276645 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 23015183 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 0 Pascal
- Sound Value at time: -0.00012147026985474729 Pascal
- Time of Minimum (Interpolation at Sinc70): 266.2413063692277 seconds
- Time of Maximum (Interpolation at Sinc70): 271.84789052462486 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.109608313869254 Pascal
- Nearest zero crossing: 0.5003749288052906 seconds
- Mean: -0.00010836550599165133 Pascal
- Root mean square: 0.18084686322522037 Pascal
- Standard Deviation: 0.18084683437593893 Pascal
- Energy: 17.068596179703054 Pa2 sec
- Power: 0.03270558793840156 Pa2
- Energy in Air: 0.04267149044925764 Joule/m2
- Power in Air: 8.17639698460039e-005 Watt/m2
- Intensity: 79.12561969389935 dB

3. Periodicity



Object type: Pitch

Object name: Kapi

Time domain:

Start time: 0 seconds

End time: 521.8862358276645 seconds

Total duration: 521.8862358276645 seconds

Time sampling:

Number of frames: 52185 (48709 voiced)

Time step: 0.01 seconds

First frame centred at: 0.023117913832219558 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 78.775442 Hz = 73.6207487 Mel = -4.13018581 semitones above 100 Hz = 2.43659122 ERB

16% = 105.405611 Hz = 96.4348109 Mel = 0.911420075 semitones above 100 Hz = 3.15284093 ERB

50% = 351.813128 Hz = 271.968975 Mel = 21.7777118 semitones above 100 Hz = 8.15045526 ERB

84% = 454.832426 Hz = 331.461783 Mel = 26.2240213 semitones above 100 Hz = 9.68563303 ERB

90% = 473.605517 Hz = 341.642519 Mel = 26.9242306 semitones above 100 Hz = 9.94194947 ERB

Estimated spreading:

84%-median = 103 Hz = 59.49 Mel = 4.446 semitones = 1.535 ERB

median-16% = 246.4 Hz = 175.5 Mel = 20.87 semitones = 4.998 ERB

90%-10% = 394.8 Hz = 268 Mel = 31.05 semitones = 7.505 ERB

Minimum 75.1516689 Hz = 70.4418068 Mel = -4.94547543 semitones above 100 Hz = 2.33526827 ERB

Maximum 599.967775 Hz = 405.664007 Mel = 31.0186202 semitones above 100 Hz = 11.5151959 ERB

Range 524.8 Hz = 335.2222 Mel = 35.96 semitones = 9.18 ERB

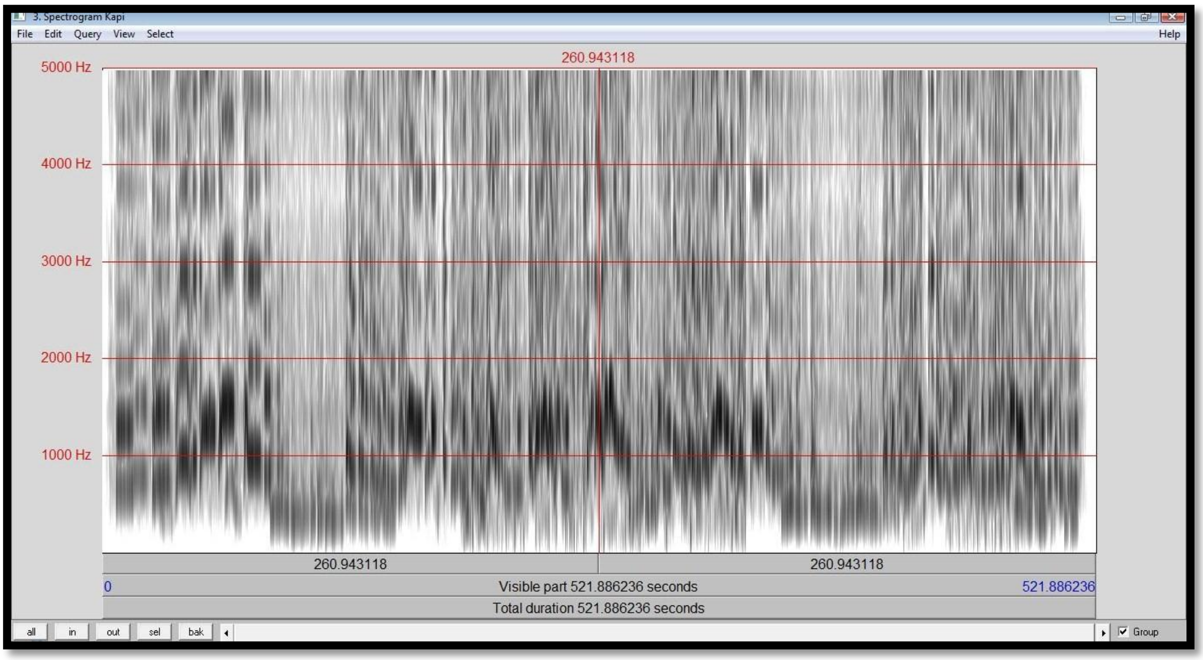
Average: 304.009614 Hz = 233.733858 Mel = 16.4344768 semitones above 100 Hz = 7.01551615 ERB

Standard deviation: 143.7 Hz = 96.95 Mel = 10.9 semitones = 2.706 ERB

Mean absolute slope: 565.3 Hz/s = 375 Mel/s = 41.05 semitones/s = 10.39 ERB/s

Mean absolute slope without octave jumps: 18.77 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Kapi

Time domain:

Start time: 0 seconds

End time: 521.8862358276645 seconds

Total duration: 521.8862358276645 seconds

Time sampling:

Number of time slices (frames): 260939

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005117913832199444 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

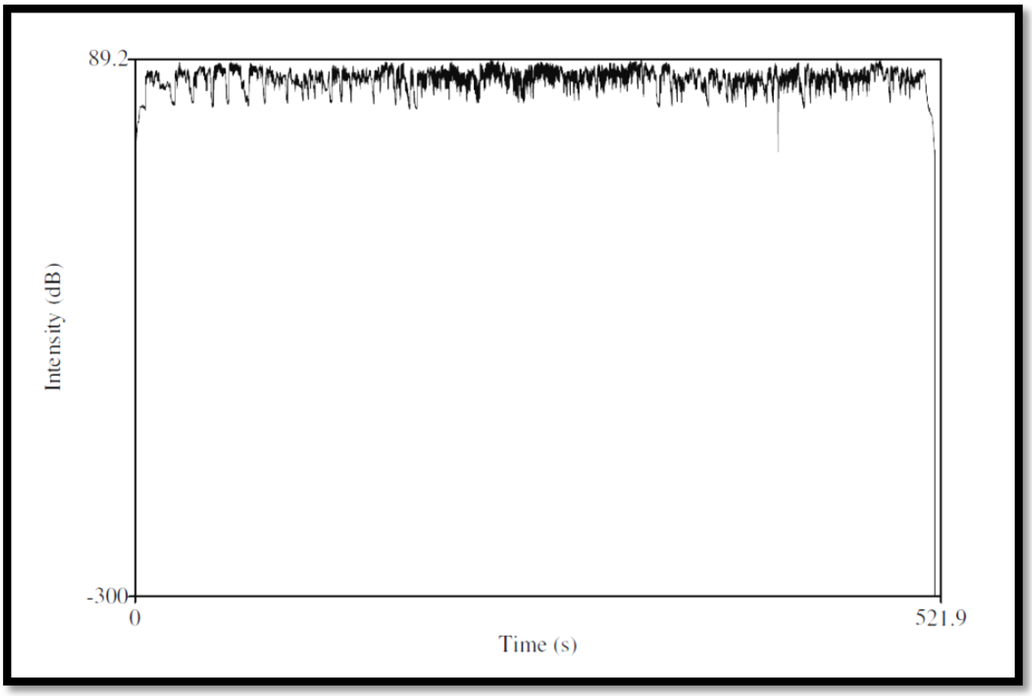
Frequency sampling:

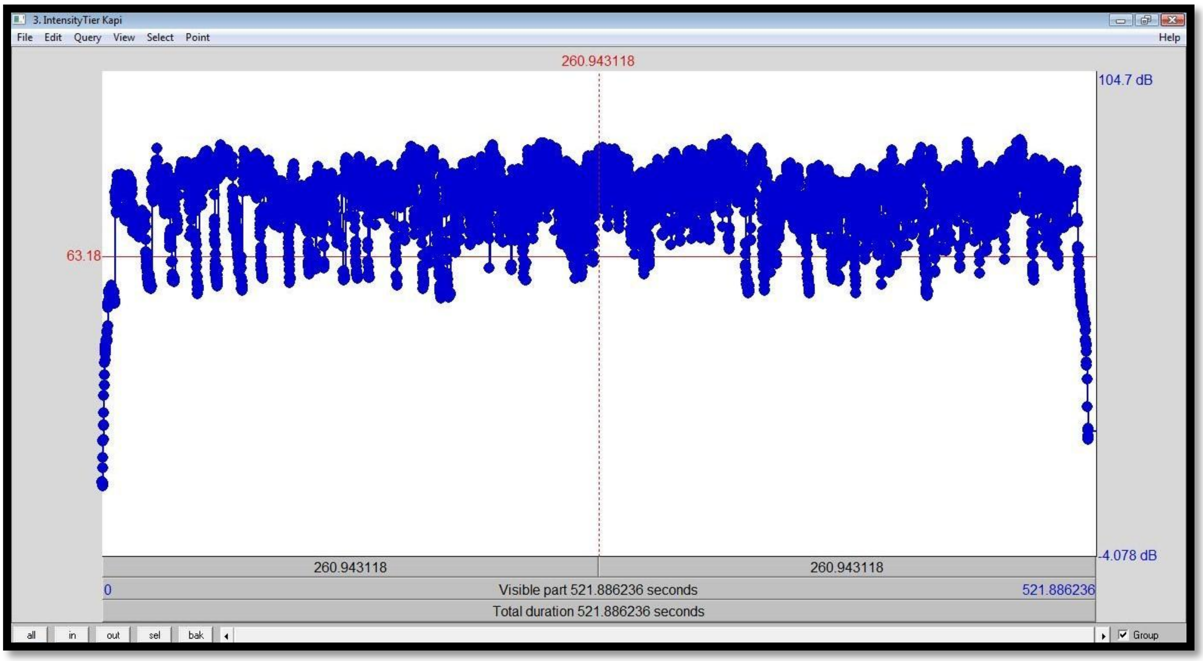
Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity





Object type: IntensityTier (Peaks)

Object name: Kapi

Domain:

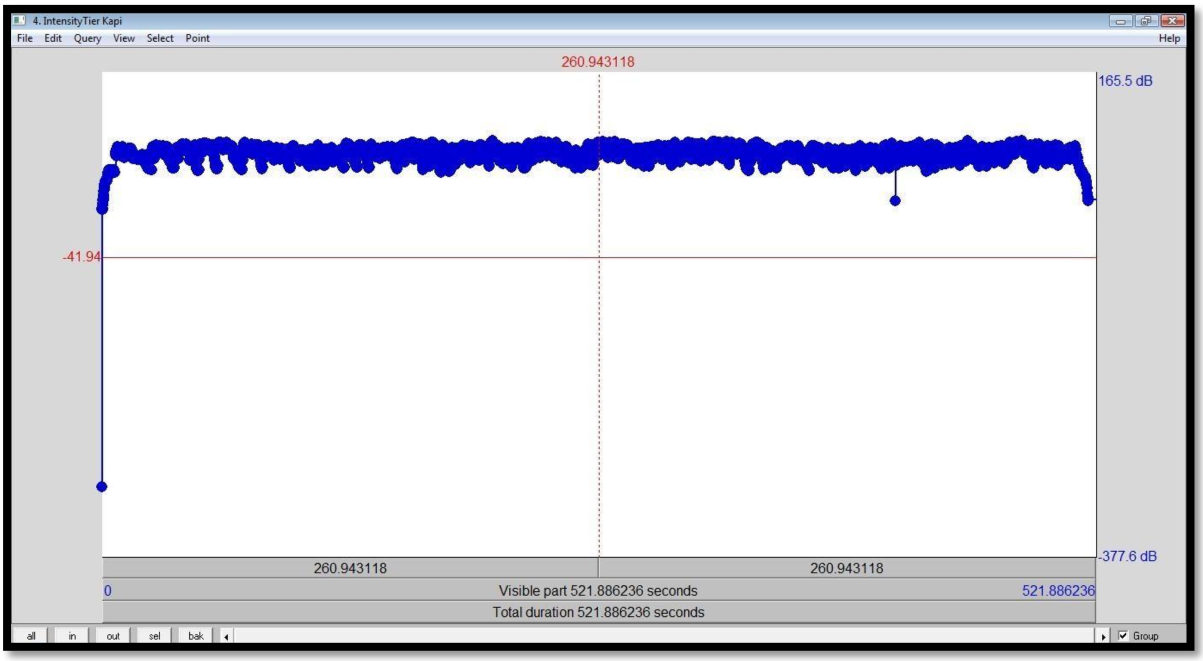
xmin: 0

xmax: 521.8862358276645

Number of points: 8291

Minimum value: 11.468729465445156

Maximum value: 89.20257280372769



Object type: IntensityTier (Valleys)

Object name: Kapi

Domain:

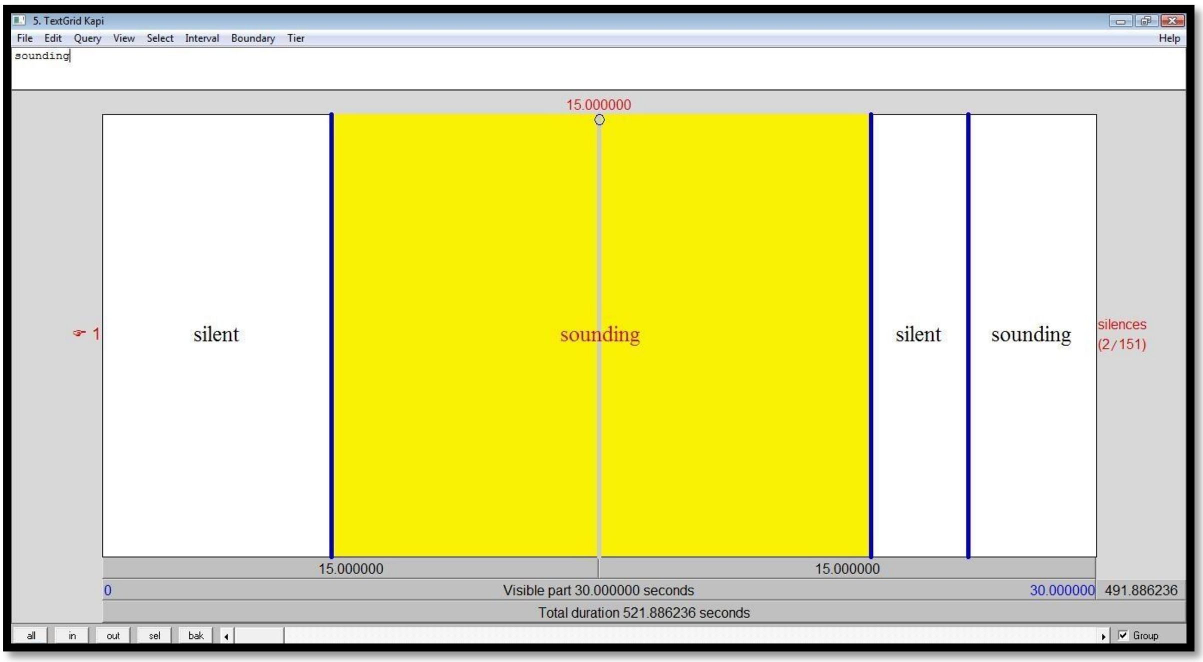
xmin: 0

xmax: 521.8862358276645

Number of points: 8291

Minimum value: -300

Maximum value: 87.93697313102855



Object type: TextGrid (Silence)

Object name: Kapi

Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 151

Number of points: 0

6. Manipulation

Object type: Manipulation

Object name: Kapi

Domain:

xmin: 0

xmax: 521.8862358276645

Data type: Manipulation

Data name: Kapi

Editor start: 0 seconds

Editor end: 521.8862358276645 seconds

Window start: 0 seconds

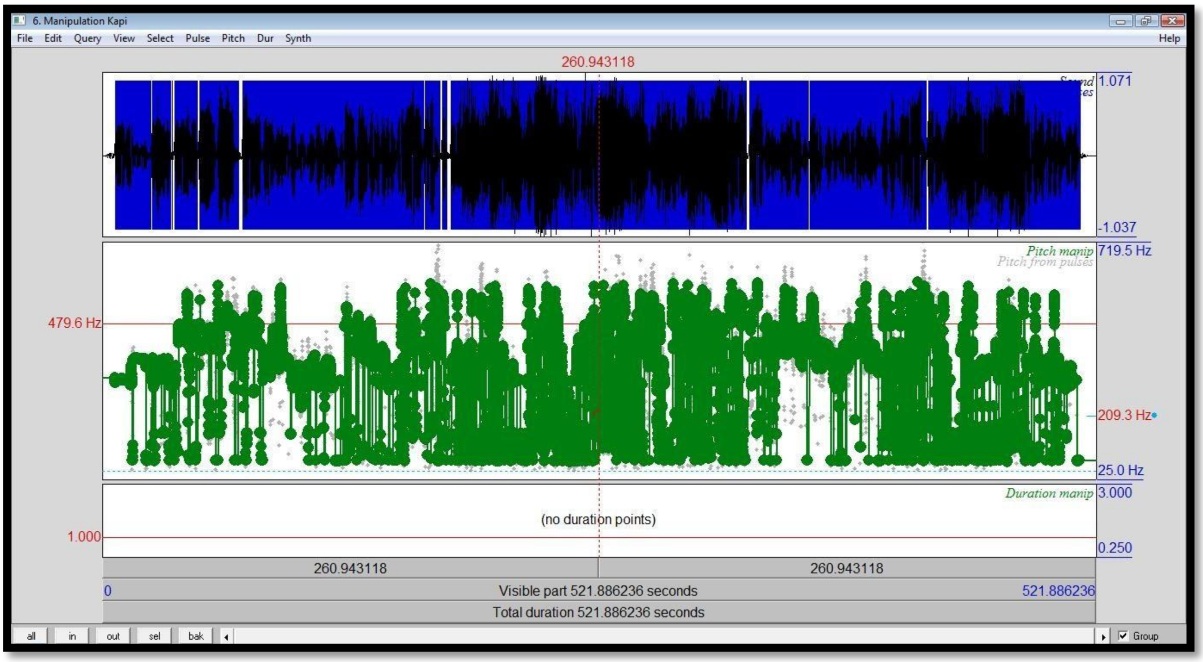
Window end: 521.8862358276645 seconds

Selection start: 260.9431179138322 seconds

Selection end: 260.9431179138322 seconds

Arrow scroll step: 0.05 seconds

Group: yes



7. Pitch Tier

Object type: PitchTier

Object name: Kapi

Time domain:

Start time: 0 seconds

End time: 521.8862358276645 seconds

Total duration: 521.8862358276645 seconds

Number of points: 46636

Minimum pitch value: 74.94276202895298 Hz

Maximum pitch value: 599.5613940978288 Hz

Data type: PitchTier

Data name: Kapi

Editor start: 0 seconds

Editor end: 521.8862358276645 seconds

Window start: 0 seconds

Window end: 521.8862358276645 seconds

Selection start: 260.9431179138322 seconds

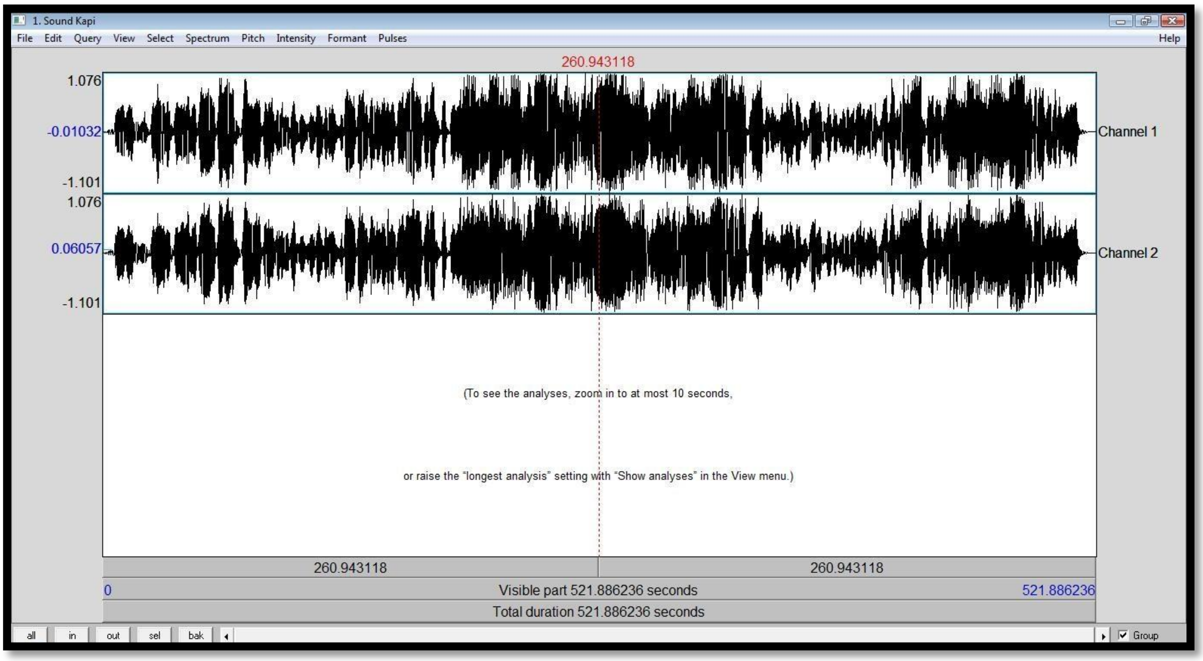
Selection end: 260.9431179138322 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Kapi

Data type: Sound

Data name: Kapi

Editor start: 0 seconds
Editor end: 521.8862358276645 seconds
Window start: 0 seconds
Window end: 521.8862358276645 seconds
Selection start: 260.9431179138322 seconds
Selection end: 260.9431179138322 seconds
Arrow scroll step: 0.05 seconds
Group: yes
Sound scaling strategy: by window
Spectrogram show: yes
Spectrogram view from: 0 Hz
Spectrogram view to: 5000 Hz
Spectrogram window length: 0.005 seconds
Spectrogram dynamic range: 70 dB
Spectrogram number of time steps: 1000
Spectrogram number of frequency steps: 250
Spectrogram method: Fourier
Spectrogram window shape: Gaussian
Spectrogram autoscaling: yes
Spectrogram maximum: 100 dB/Hz
Spectrogram pre-emphasis: 6 dB/octave
Spectrogram dynamicCompression: 0
Spectrogram cursor frequency: 0 Hz
Pitch show: yes
Pitch floor: 75 Hz
Pitch ceiling: 500 Hz
Pitch unit: Hertz
Pitch drawing method: automatic
Pitch view from: 0 Hertz
Pitch view to: 0 Hertz
Pitch method: autocorrelation
Pitch very accurate: no
Pitch max. number of candidates: 15
Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

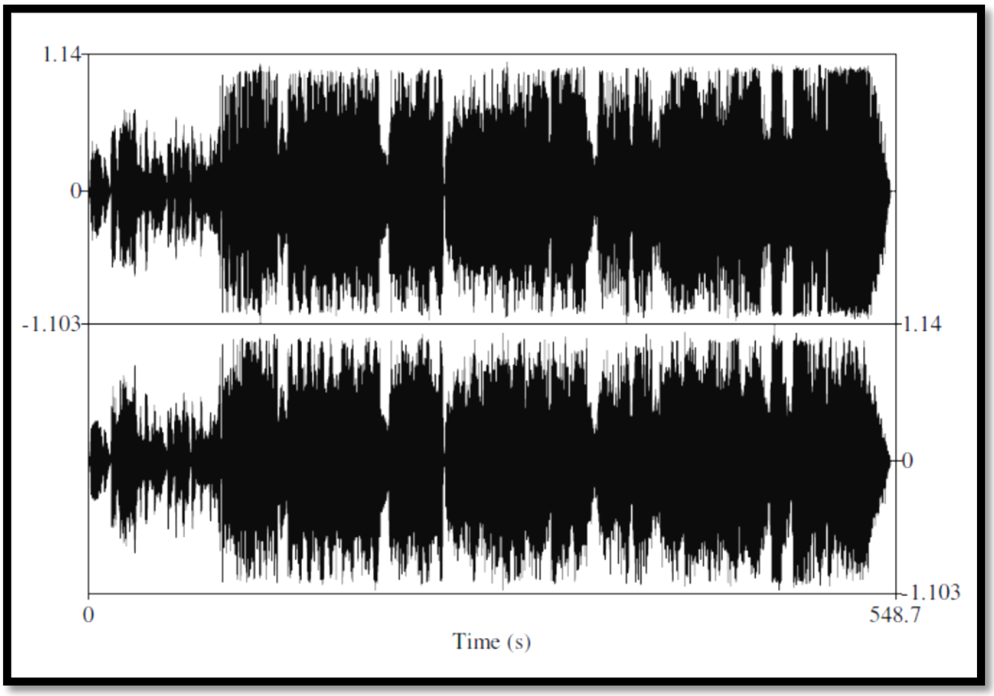
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Bilahari Ragam (Track 4)

1. Sound Draw



Object type: Sound

Object name: Bilahari

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 548.6878684807256 seconds

Total duration: 548.6878684807256 seconds

Time sampling:

Number of samples: 24197135

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.10292019 Pascal

Maximum: 1.14001483 Pascal

Mean: -0.000112654815 Pascal

Root-mean-square: 0.188331814 Pascal

Total energy: 19.4613398 Pascal² sec (energy in air: 0.0486533495 Joule/m²)

Mean power (intensity) in air: 8.867218e-005 Watt/m² = 79.48 dB

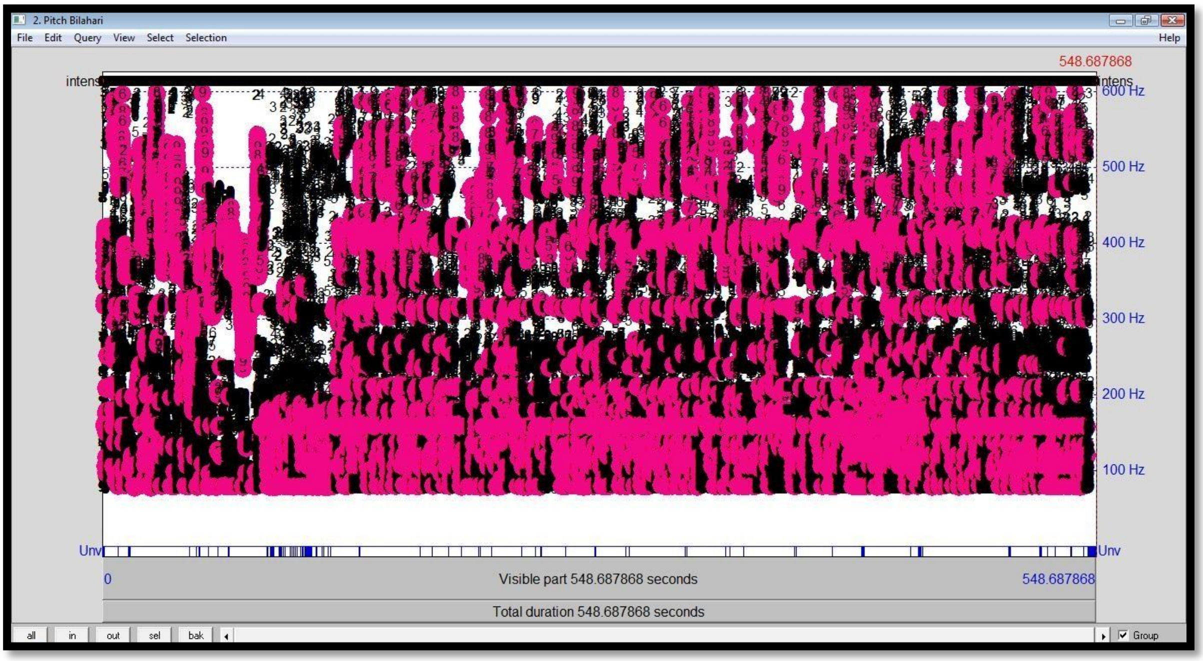
Standard deviation in channel 1: 0.18854906 Pascal

Standard deviation in channel 2: 0.188114256 Pascal

2. Query

- Total Duration: 548.6878684807256 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 24197135 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 0 Pascal
- Sound Value at time: -3.054233644892921e-005 Pascal
- Time of Minimum (Interpolation at Sinc70): 117.1879509825083 seconds
- Time of Maximum (Interpolation at Sinc70): 466.5661671686157 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.1472089639106013 Pascal
- Nearest zero crossing: 0.09498346560846561 seconds
- Mean: -0.00011265481496254104 Pascal
- Root mean square: 0.18833181359287504 Pascal
- Standard Deviation: 0.18833178371422435 Pascal
- Energy: 19.461339781230812 Pa2 sec
- Power: 0.035468872011181436 Pa2
- Energy in Air: 0.048653349453077026 Joule/m2
- Power in Air: 8.86721800279536e-005 Watt/m2
- Intensity: 79.47787385835576 dB

3. Periodicity



Object type: Pitch

Object name: Bilahari

Time domain:

Start time: 0 seconds

End time: 548.6878684807256 seconds

Total duration: 548.6878684807256 seconds

Time sampling:

Number of frames: 54865 (49388 voiced)

Time step: 0.01 seconds

First frame centred at: 0.023934240362835892 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 78.8239864 Hz = 73.6632097 Mel = -4.11952057 semitones above 100 Hz = 2.43794199 ERB

16% = 104.630275 Hz = 95.7837828 Mel = 0.783604303 semitones above 100 Hz = 3.13265898 ERB

50% = 185.080938 Hz = 159.534284 Mel = 10.6578758 semitones above 100 Hz = 5.0441466 ERB

84% = 417.941176 Hz = 310.889171 Mel = 24.7595988 semitones above 100 Hz = 9.16216366 ERB

90% = 471.06091 Hz = 340.273558 Mel = 26.8309634 semitones above 100 Hz = 9.90758652 ERB

Estimated spreading:

84%-median = 232.9 Hz = 151.4 Mel = 14.1 semitones = 4.118 ERB

median-16% = 80.45 Hz = 63.75 Mel = 9.874 semitones = 1.912 ERB

90%-10% = 392.2 Hz = 266.6 Mel = 30.95 semitones = 7.47 ERB

Minimum 75.9436298 Hz = 71.1381223 Mel = -4.76398967 semitones above 100 Hz = 2.35749487 ERB

Maximum 599.612756 Hz = 405.494184 Mel = 31.0083729 semitones above 100 Hz = 11.5111062 ERB

Range 523.7 Hz = 334.356062 Mel = 35.77 semitones = 9.154 ERB

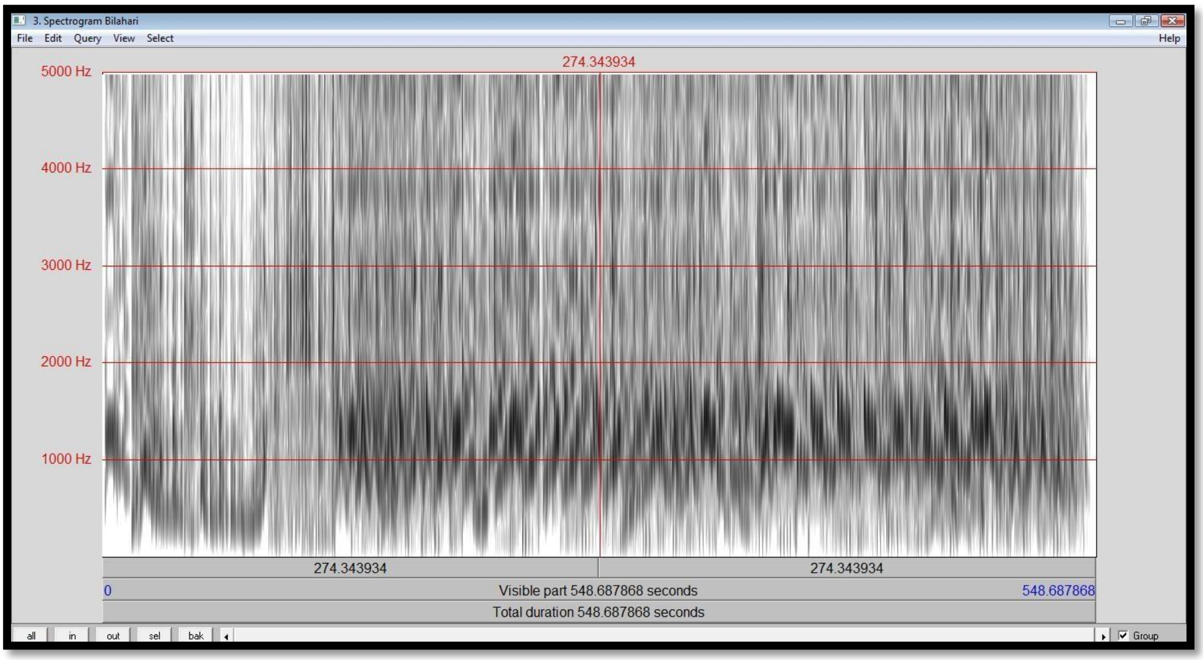
Average: 245.572178 Hz = 194.600759 Mel = 12.4596042 semitones above 100 Hz = 5.93420875 ERB

Standard deviation: 142 Hz = 95.37 Mel = 10.58 semitones = 2.655 ERB

Mean absolute slope: 739.1 Hz/s = 502.5 Mel/s = 58.44 semitones/s = 14.1 ERB/s

Mean absolute slope without octave jumps: 26.74 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Bilahari

Time domain:

Start time: 0 seconds

End time: 548.6878684807256 seconds

Total duration: 548.6878684807256 seconds

Time sampling:

Number of time slices (frames): 274339

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005934240362811699 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

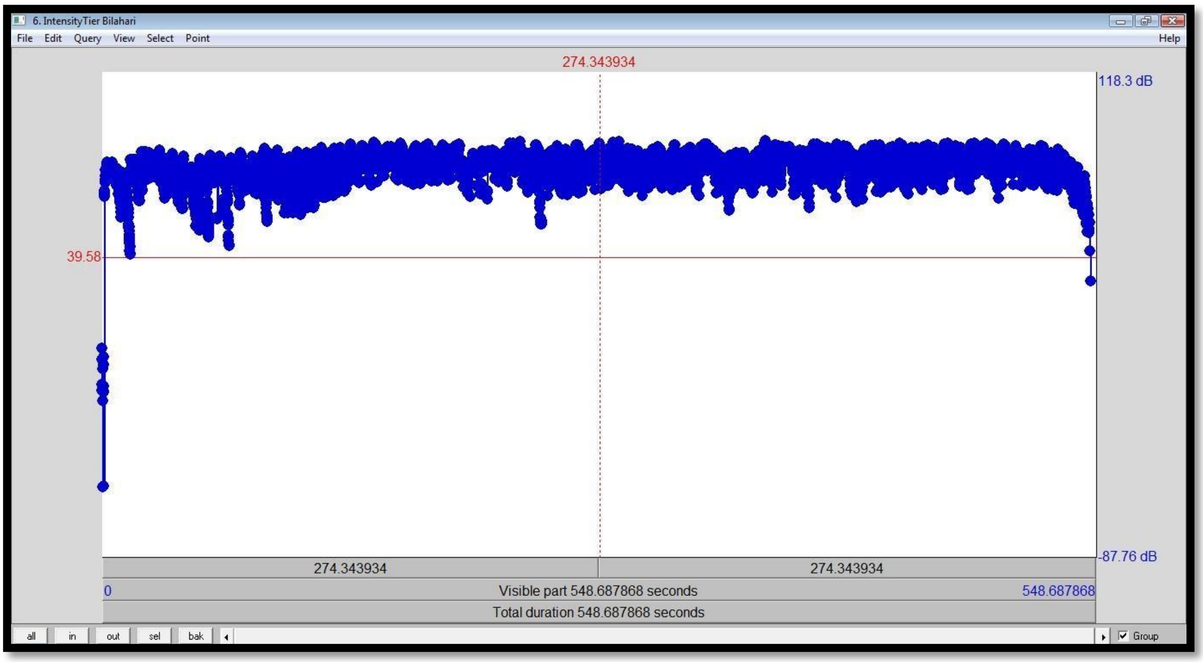
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peaks)

Object name: Bilahari

Domain:

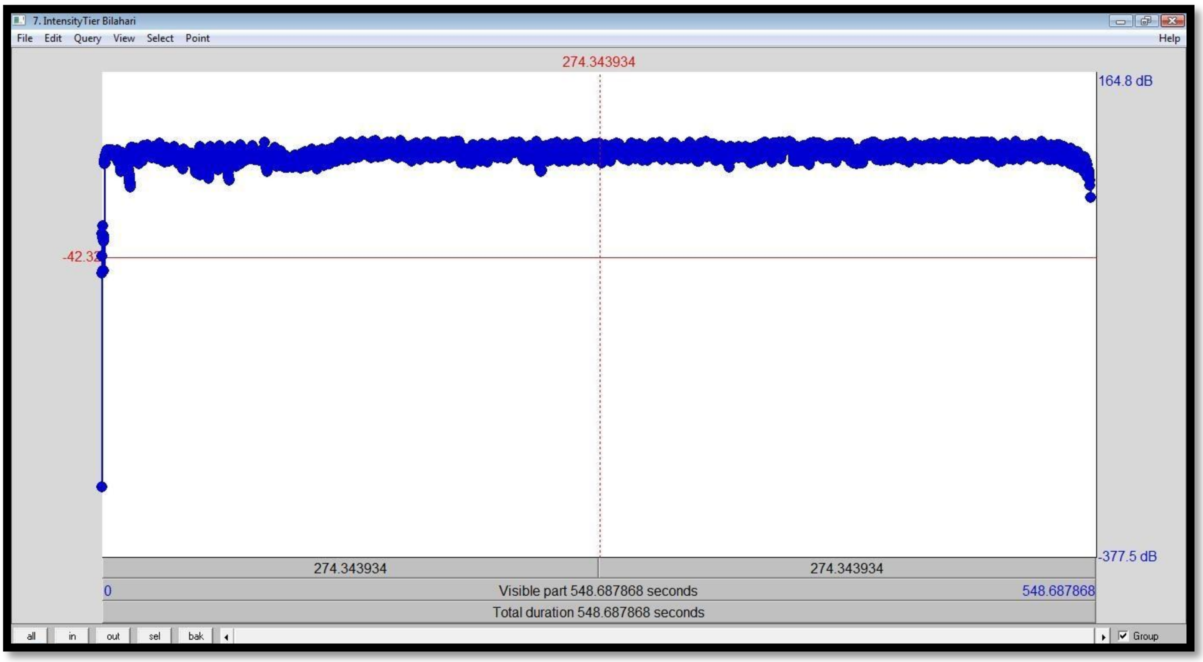
xmin: 0

xmax: 548.6878684807256

Number of points: 7496

Minimum value: -58.32020011336006

Maximum value: 88.85823436415397



Object type: IntensityTier (Valleys)

Object name: Bilahari

Domain:

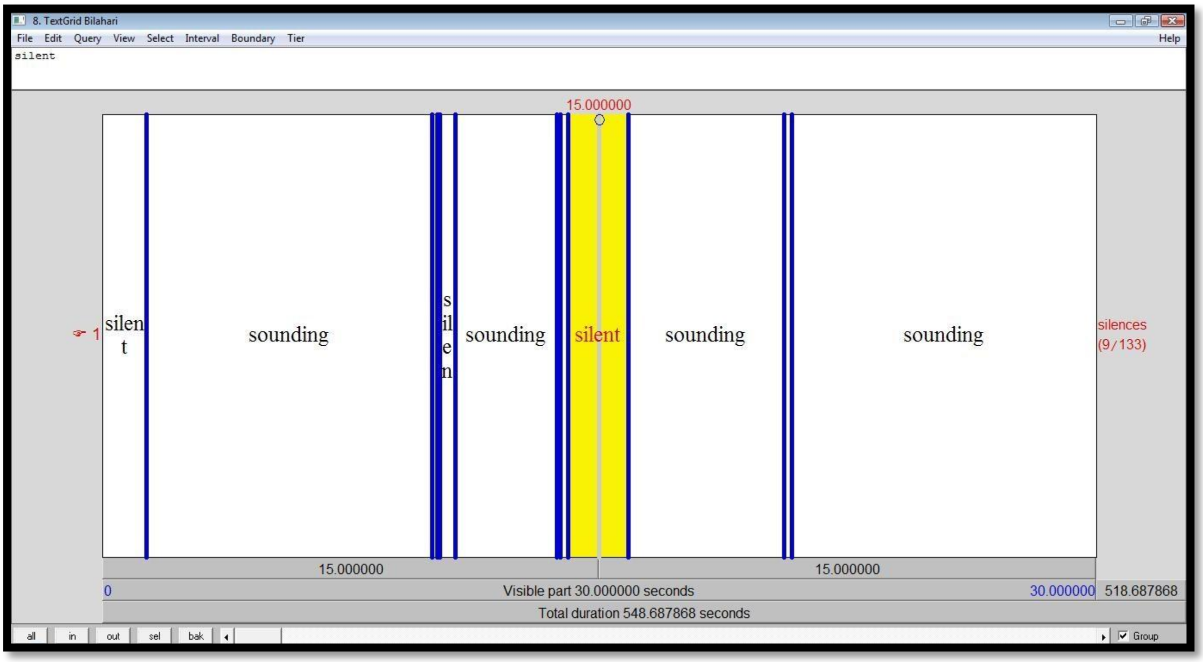
xmin: 0

xmax: 548.6878684807256

Number of points: 7496

Minimum value: -300

Maximum value: 87.36984556169912



Object type: TextGrid (Silences)

Object name: Bilahari

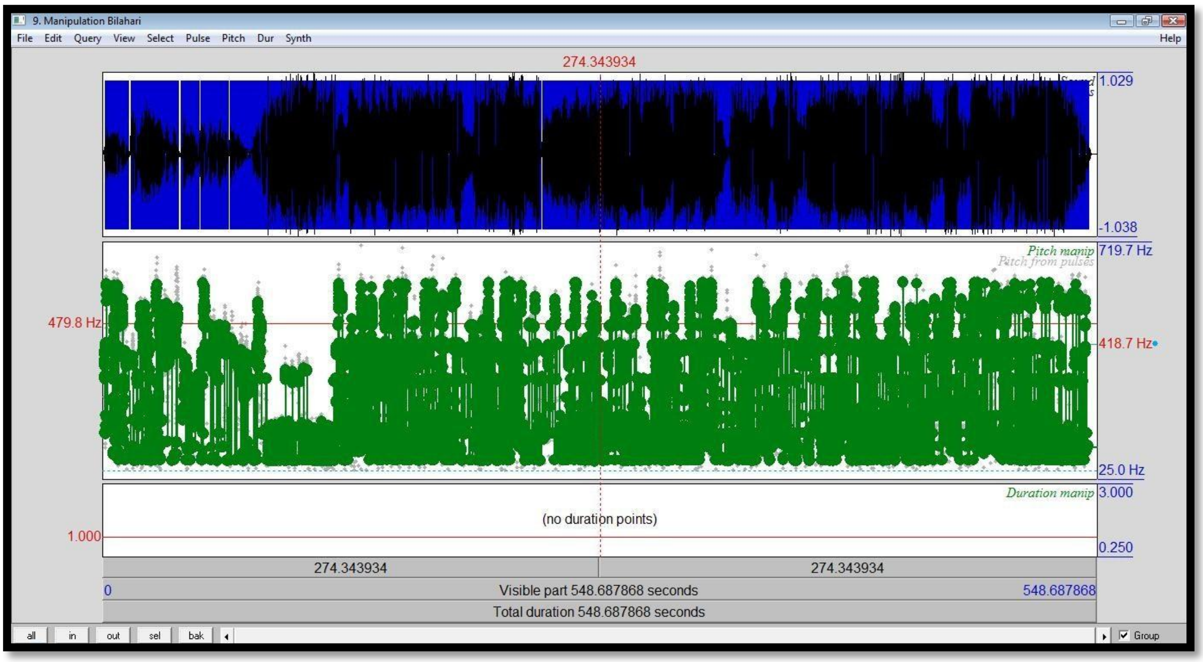
Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 133

Number of points: 0

6. Manipulation



Object type: Manipulation

Object name: Bilahari

Domain:

xmin: 0

xmax: 548.6878684807256

Editor type: ManipulationEditor

Editor name: 9. Manipulation Bilahari

Data type: Manipulation

Data name: Bilahari

Editor start: 0 seconds

Editor end: 548.6878684807256 seconds

Window start: 0 seconds

Window end: 548.6878684807256 seconds

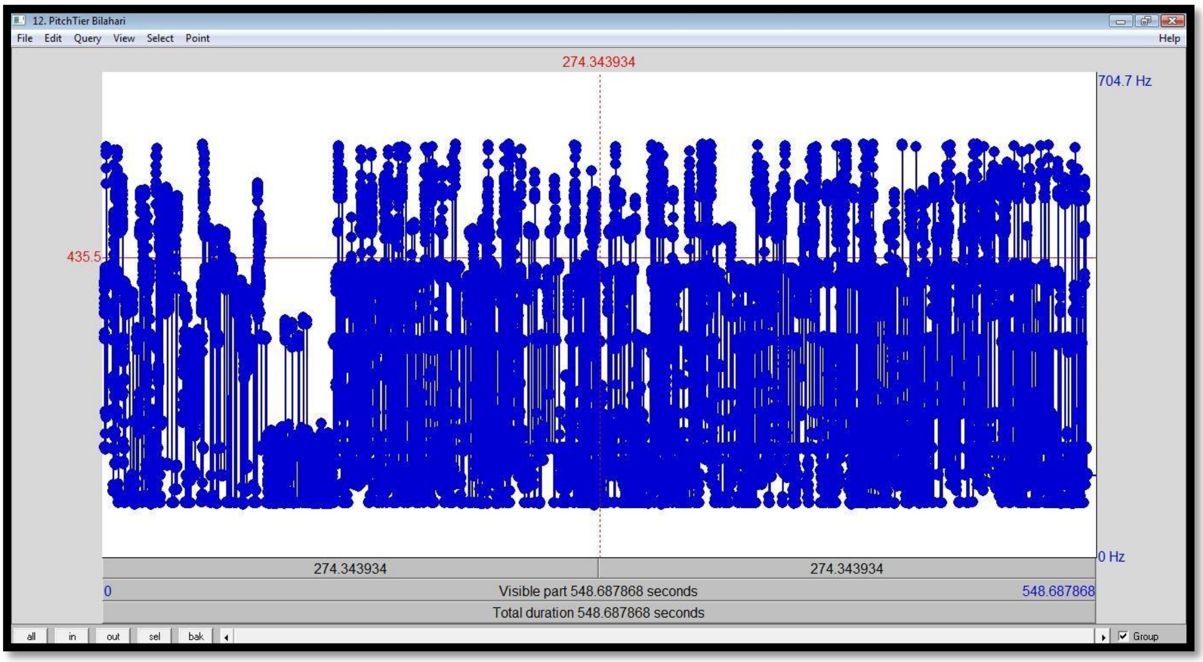
Selection start: 274.3439342403628 seconds

Selection end: 274.3439342403628 seconds

Arrow scroll step: 0.05 seconds

Group: yes

7. Pitch Tier



Object type: PitchTier

Object name: Bilahari

Time domain:

Start time: 0 seconds

End time: 548.6878684807256 seconds

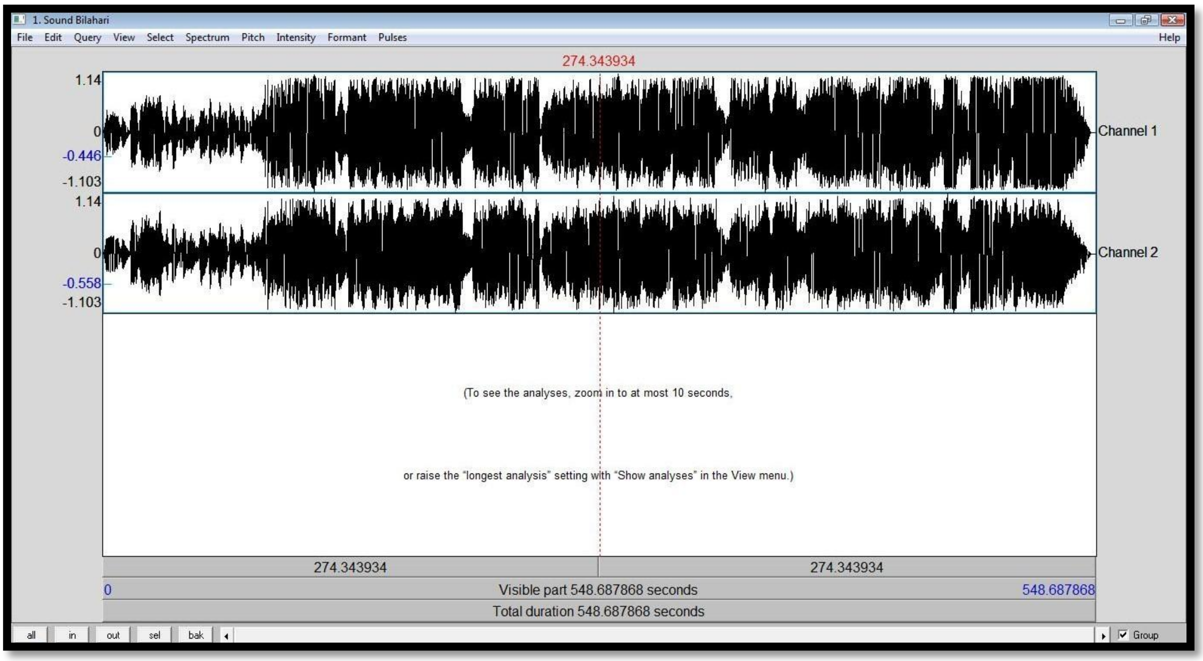
Total duration: 548.6878684807256 seconds

Number of points: 48215

Minimum pitch value: 75.09514077268375 Hz

Maximum pitch value: 599.7327503266657 Hz

8. Visible Sound



Editor type: Sound Editor

Editor name: 1. Sound Bilahari

Data type: Sound

Data name: Bilahari

Editor start: 0 seconds

Editor end: 548.6878684807256 seconds

Window start: 0 seconds

Window end: 548.6878684807256 seconds

Selection start: 274.3439342403628 seconds

Selection end: 274.3439342403628 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

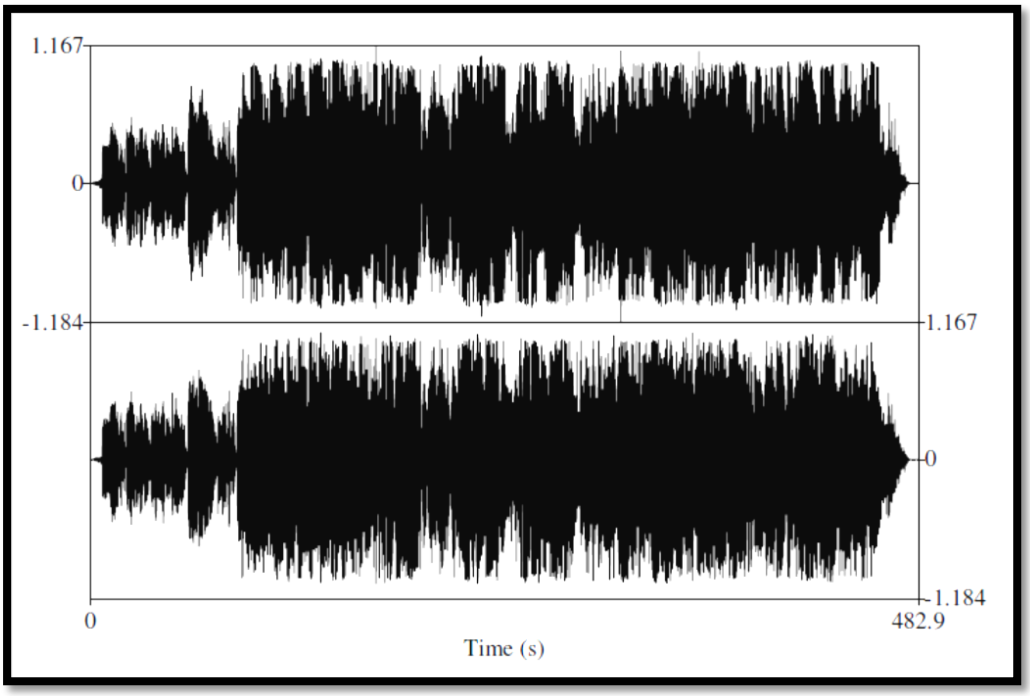
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Kanada Ragam (Track 5)

1. **Sound Draw**



Object type: Sound

Object name: Kanada

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 482.8854195011338 seconds

Total duration: 482.8854195011338 seconds

Time sampling:

Number of samples: 21295247

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.18404923 Pascal

Maximum: 1.16708608 Pascal

Mean: -0.000117254615 Pascal

Root-mean-square: 0.204316595 Pascal

Total energy: 20.1581828 Pascal² sec (energy in air: 0.050395457 Joule/m²)

Mean power (intensity) in air: 0.000104363178 Watt/m² = 80.19 dB

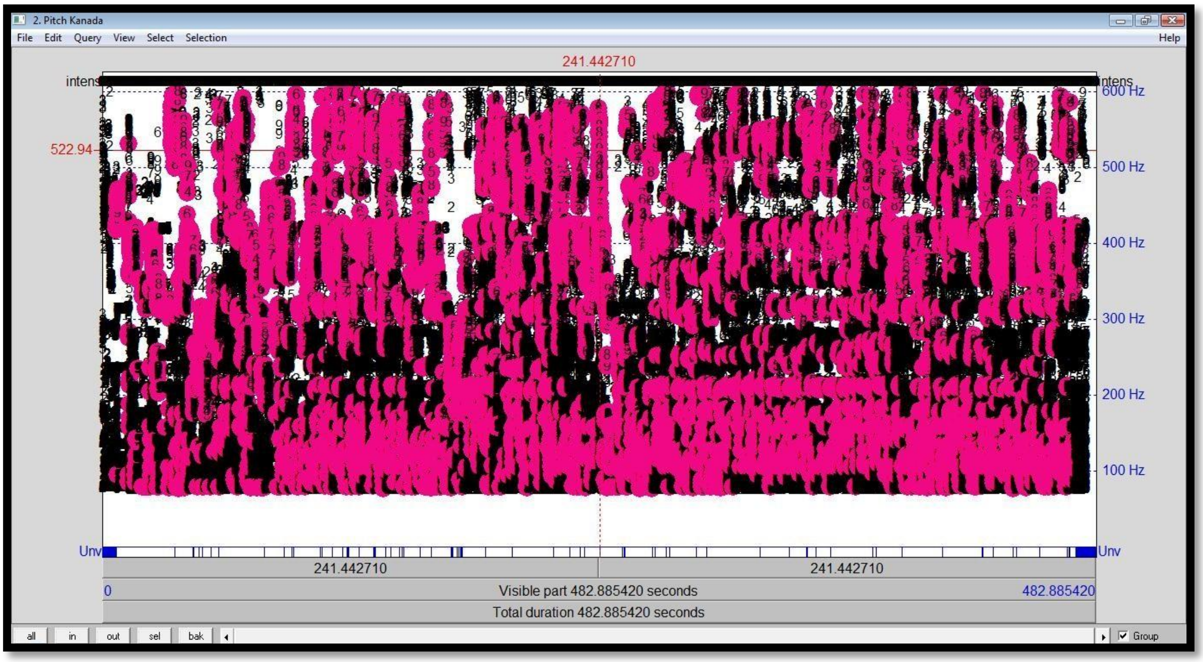
Standard deviation in channel 1: 0.204292238 Pascal

Standard deviation in channel 2: 0.204340892 Pascal

2. Query

- Total Duration: 482.8854195011338 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 21295247 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: -1.1461765891207477e-005 Pascal
- Time of Minimum (Interpolation at Sinc70): 309.5250140613455 seconds
- Time of Maximum (Interpolation at Sinc70): 166.82909895537466 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.19020742709818 Pascal
- Nearest zero crossing: 0.5000325223974173 seconds
- Mean: -0.00011725461453811796 Pascal
- Root mean square: 0.20431659544469397 Pascal
- Standard Deviation: 0.20431656650959576 Pascal
- Energy: 20.158182783099054 Pa2 sec
- Power: 0.04174527117411074 Pa2
- Energy in Air: 0.05039545695774763 Joule/m2
- Power in Air: 0.00010436317793527685 Watt/m2
- Intensity: 80.18547295214893 dB

3. Periodicity



Object type: Pitch

Object name: Kanada

Time domain:

Start time: 0 seconds

End time: 482.8854195011338 seconds

Total duration: 482.8854195011338 seconds

Time sampling:

Number of frames: 48285 (44016 voiced)

Time step: 0.01 seconds

First frame centred at: 0.022709750566900288 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 103.964449 Hz = 95.2240918 Mel = 0.673083328 semitones above 100 Hz = 3.11529673 ERB

16% = 105.568825 Hz = 96.5717583 Mel = 0.938206287 semitones above 100 Hz = 3.15708445 ERB

50% = 209.942943 Hz = 177.828793 Mel = 12.8399676 semitones above 100 Hz = 5.57063671 ERB

84% = 417.927822 Hz = 310.881583 Mel = 24.7590456 semitones above 100 Hz = 9.16196918 ERB

90% = 468.221961 Hz = 338.742212 Mel = 26.7263112 semitones above 100 Hz = 9.86910983 ERB

Estimated spreading:

84%-median = 208 Hz = 133.1 Mel = 11.92 semitones = 3.591 ERB

median-16% = 104.4 Hz = 81.26 Mel = 11.9 semitones = 2.414 ERB

90%-10% = 364.3 Hz = 243.5 Mel = 26.05 semitones = 6.754 ERB

Minimum 75.5217295 Hz = 70.7672848 Mel = -4.86043548 semitones above 100 Hz = 2.34565993 ERB

Maximum 599.99043 Hz = 405.674842 Mel = 31.0192739 semitones above 100 Hz = 11.5154568 ERB

Range 524.5 Hz = 334.907557 Mel = 35.88 semitones = 9.17 ERB

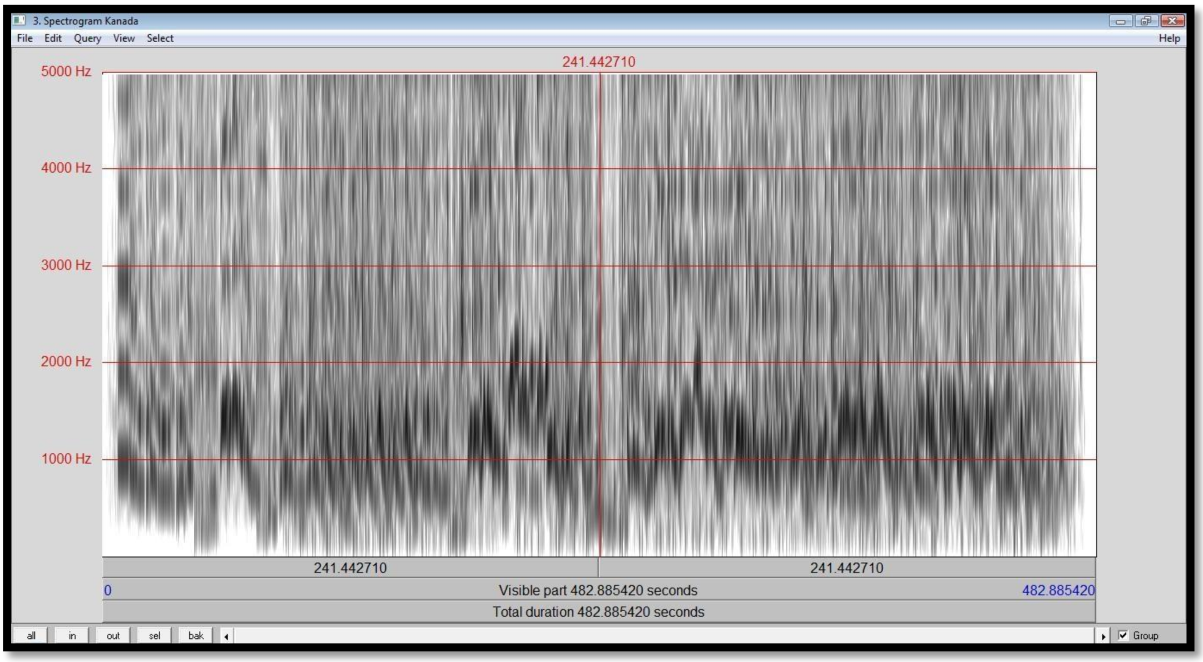
Average: 253.771712 Hz = 200.687818 Mel = 13.3078933 semitones above 100 Hz = 6.11159177 ERB

Standard deviation: 139.2 Hz = 92.97 Mel = 10.13 semitones = 2.582 ERB

Mean absolute slope: 882.2 Hz/s = 596 Mel/s = 67.26 semitones/s = 16.65 ERB/s

Mean absolute slope without octave jumps: 29.17 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Kanada

Time domain:

Start time: 0 seconds

End time: 482.8854195011338 seconds

Total duration: 482.8854195011338 seconds

Time sampling:

Number of time slices (frames): 241438

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005709750566893345 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

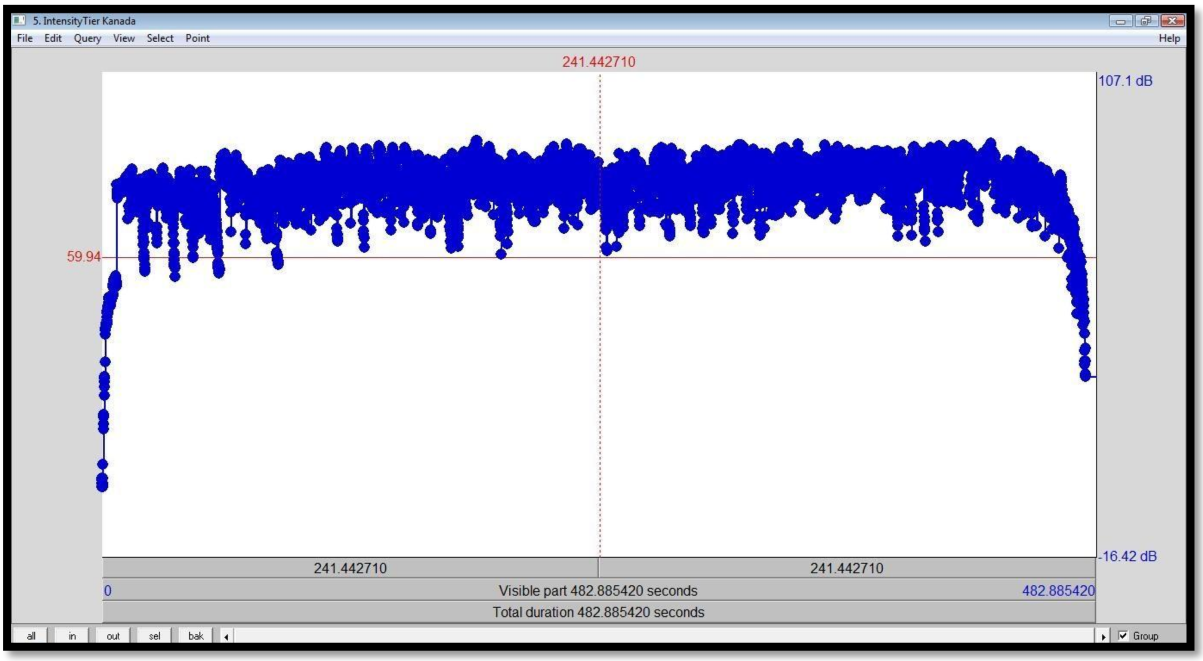
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peaks)

Object name: Kanada

Domain:

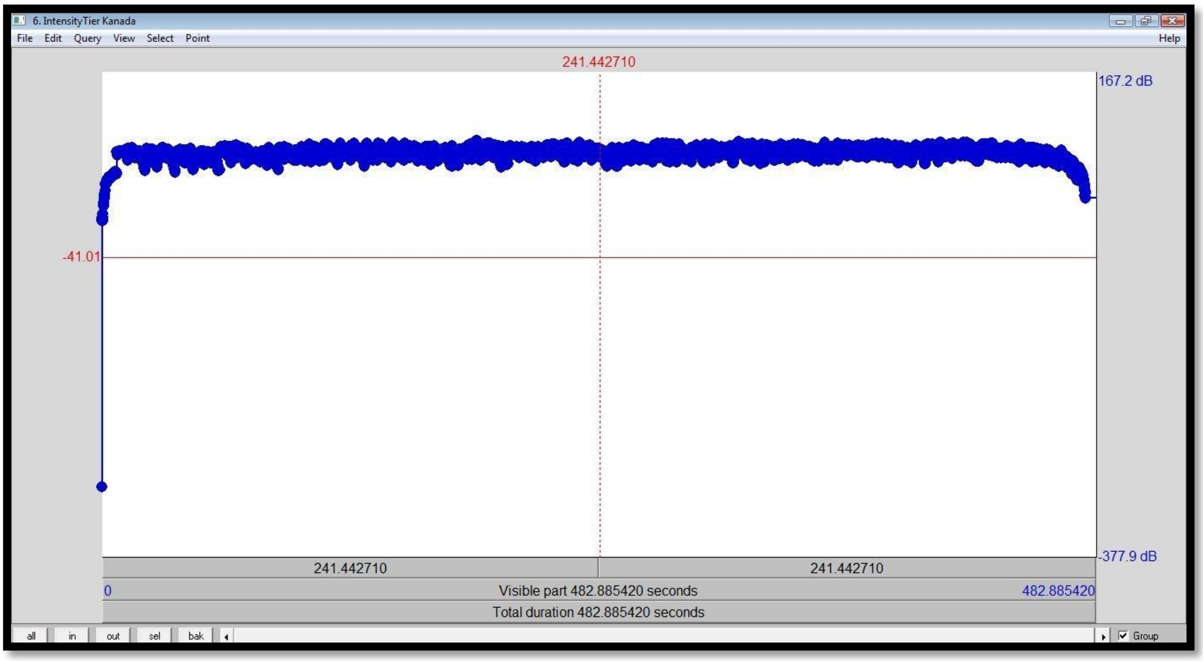
xmin: 0

xmax: 482.8854195011338

Number of points: 7237

Minimum value: 1.232140404337577

Maximum value: 89.4875306526516



Object type: Intensity Tier (Valleys)

Object name: Kanada

Domain:

xmin: 0

xmax: 482.8854195011338

Number of points: 7237

Minimum value: -300

Maximum value: 89.34013142283943

Object type: Text Grid (Silences)

Object name: Kanada

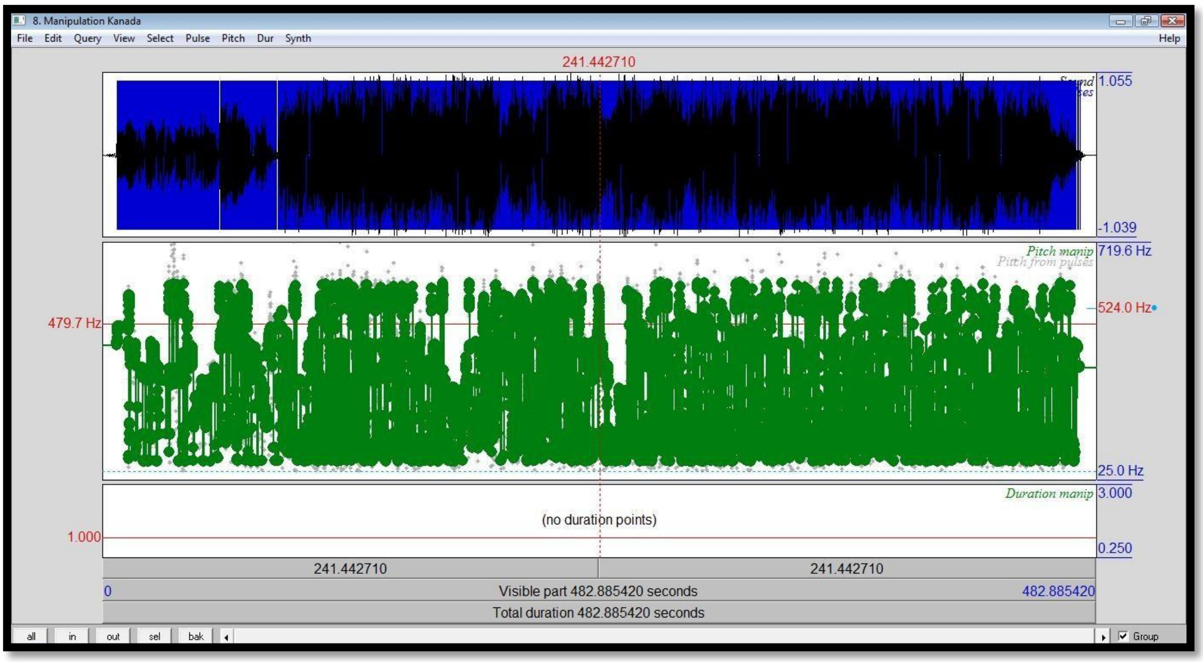
Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 41

Number of points: 0

6. Manipulation



Object type: Manipulation

Object name: Kanada

Domain:

xmin: 0

xmax: 482.8854195011338

Editor type: ManipulationEditor

Editor name: 8. Manipulation Kanada

Data type: Manipulation

Data name: Kanada

Editor start: 0 seconds

Editor end: 482.8854195011338 seconds

Window start: 0 seconds

Window end: 482.8854195011338 seconds

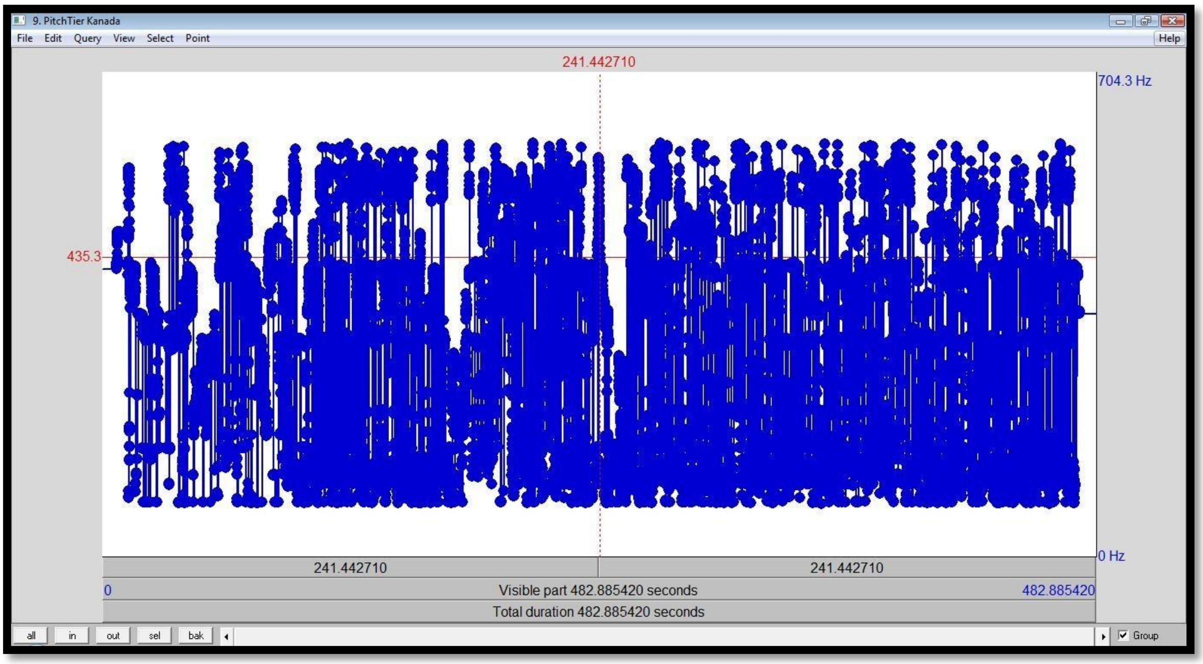
Selection start: 241.4427097505669 seconds

Selection end: 241.4427097505669 seconds

Arrow scroll step: 0.05 seconds

Group: yes

7. Pitch Tier



Object type: PitchTier

Object name: Kanada

Time domain:

Start time: 0 seconds

End time: 482.8854195011338 seconds

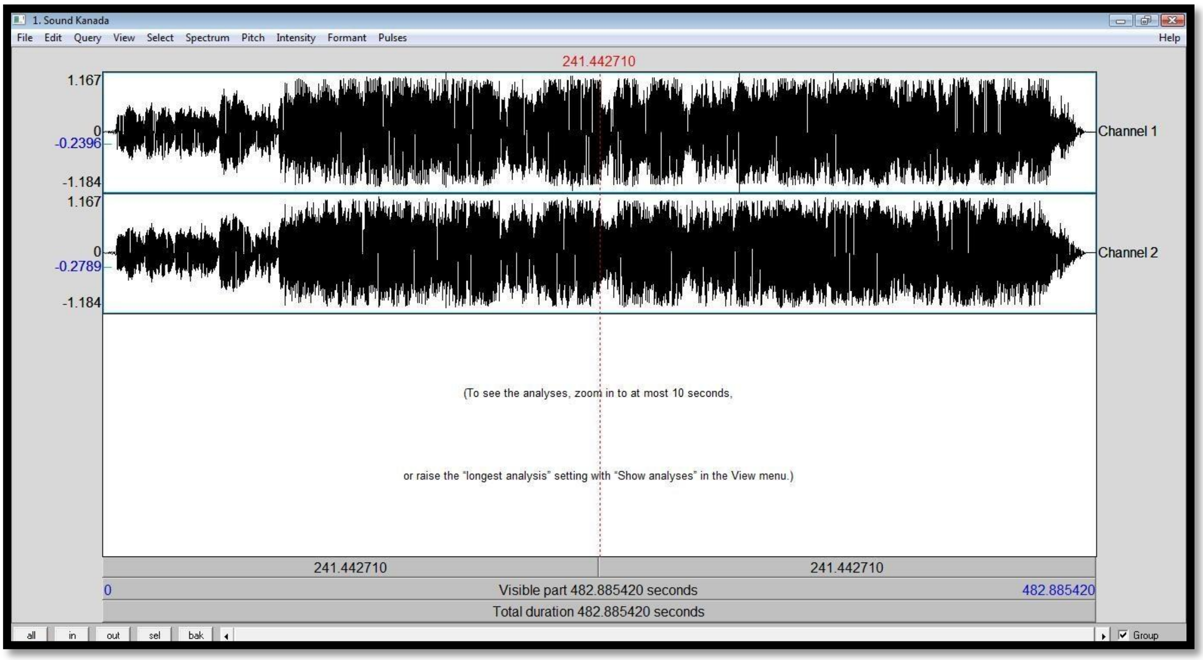
Total duration: 482.8854195011338 seconds

Number of points: 43478

Minimum pitch value: 76.39501548398373 Hz

Maximum pitch value: 599.6776289873875 Hz

8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Kanada

Data type: Sound

Data name: Kanada

Editor start: 0 seconds

Editor end: 482.8854195011338 seconds

Window start: 0 seconds

Window end: 482.8854195011338 seconds

Selection start: 241.4427097505669 seconds

Selection end: 241.4427097505669 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

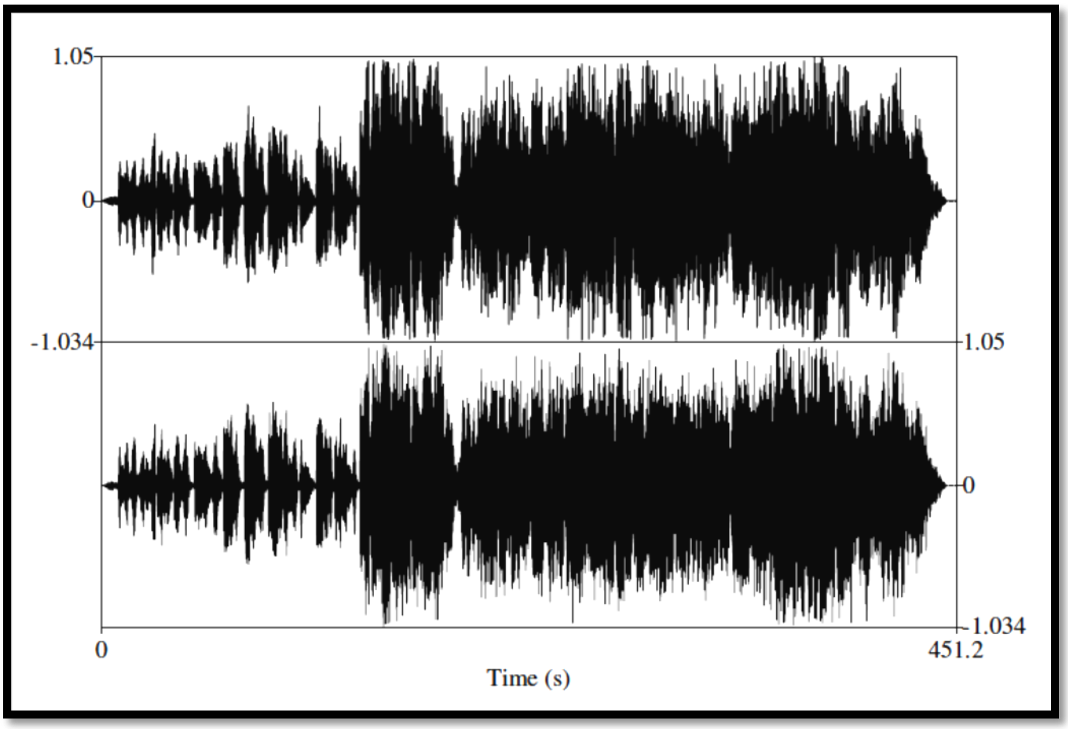
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Senchurutti Ragam (Track 6)

1. **Sound Draw**



Object type: Sound

Object name: Senchurutti

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 451.22501133786847 seconds

Total duration: 451.22501133786847 seconds

Time sampling:

Number of samples: 19899023

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.03389943 Pascal

Maximum: 1.05022275 Pascal

Mean: -9.42402824e-005 Pascal

Root-mean-square: 0.173455502 Pascal

Total energy: 13.5759217 Pascal² sec (energy in air: 0.0339398042 Joule/m²)

Mean power (intensity) in air: 7.52170278e-005 Watt/m² = 78.76 dB

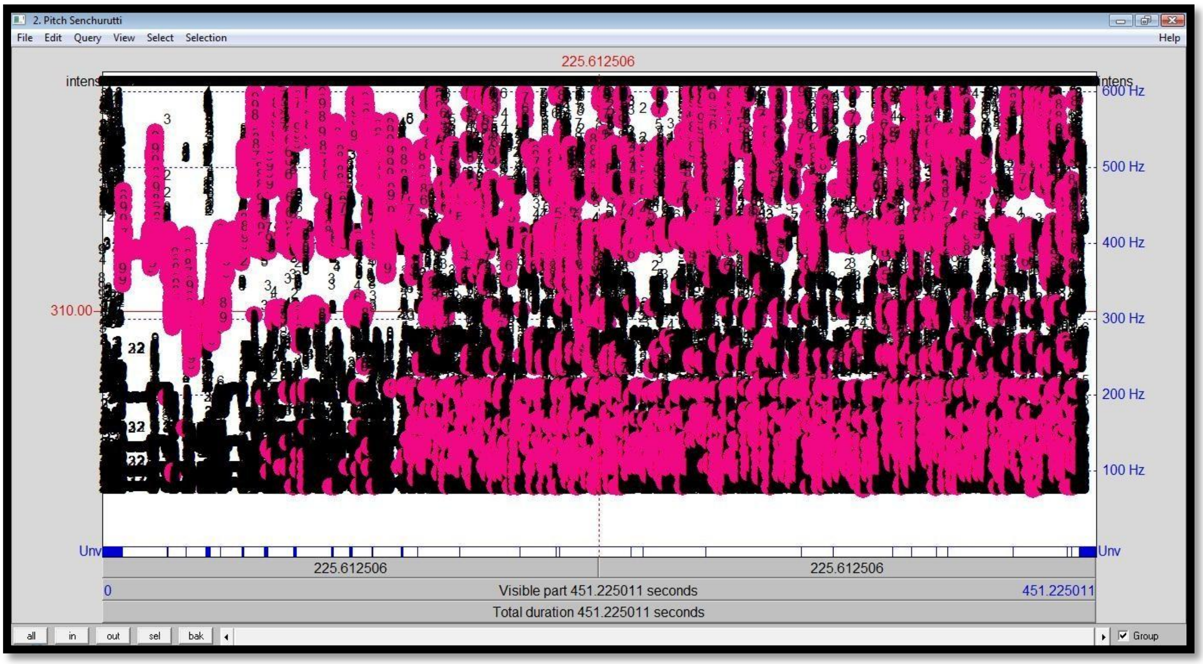
Standard deviation in channel 1: 0.173562252 Pascal

Standard deviation in channel 2: 0.173348643 Pascal

2. **Query**

- Total Duration: 451.22501133786847 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 19899023 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: -4.893057308544052e-005 Pascal
- Time of Minimum (Interpolation at Sinc70): 279.5754654844455 seconds
- Time of Maximum (Interpolation at Sinc70): 380.25496661823234 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.0685027081807452 Pascal
- Nearest zero crossing: 1.0685027081807452 Pascal
- Mean: 0.5000223353102989 seconds
- Root mean square: 0.17345550188760092 Pascal
- Standard Deviation: 0.17345548049800358 Pascal
- Energy: 13.575921695546567 Pa2 sec
- Power: 0.030086811135079525 Pa2
- Energy in Air: 0.03393980423886642 Joule/m2
- Power in Air: 7.521702783769882e-005 Watt/m2
- Intensity: 78.76316168501577 dB

3. Periodicity



Object type: Pitch

Object name: Senchurutti

Time domain:

Start time: 0 seconds

End time: 451.22501133786847 seconds

Total duration: 451.22501133786847 seconds

Time sampling:

Number of frames: 45119 (41120 voiced)

Time step: 0.01 seconds

First frame centred at: 0.022505668934228 28 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 113.726666 Hz = 103.373676 Mel = 2.22684683 semitones above 100 Hz = 3.3670418 ERB

16% = 138.200583 Hz = 123.289134 Mel = 5.60116438 semitones above 100 Hz = 3.97293314 ERB

50% = 376.456197 Hz = 286.796668 Mel = 22.9497841 semitones above 100 Hz = 8.53931609 ERB

84% = 475.630496 Hz = 342.729498 Mel = 26.9980946 semitones above 100 Hz = 9.96921171 ERB

90% = 520.96778 Hz = 366.519839 Mel = 28.5743298 semitones above 100 Hz = 10.5609862 ERB

Estimated spreading:

84%-median = 99.18 Hz = 55.93 Mel = 4.048 semitones = 1.43 ERB

median-16% = 238.3 Hz = 163.5 Mel = 17.35 semitones = 4.566 ERB

90%-10% = 407.2 Hz = 263.1 Mel = 26.35 semitones = 7.194 ERB

Minimum 74.9688165 Hz = 70.2809122 Mel = -4.98764961 semitones above 100 Hz = 2.33012984 ERB

Maximum 599.987198 Hz = 405.673296 Mel = 31.0191806 semitones above 100 Hz = 11.5154195 ERB

Range 525 Hz = 335.392384 Mel = 36.01 semitones = 9.185 ERB

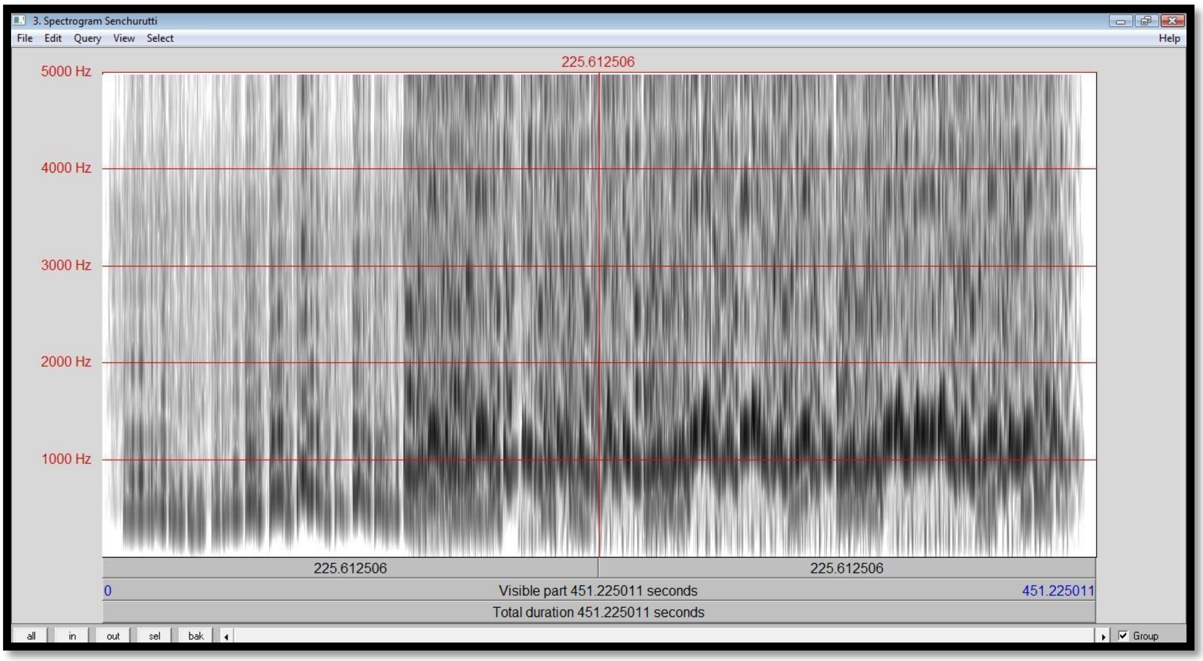
Average: 321.019516 Hz = 244.788025 Mel = 17.8713701 semitones above 100 Hz = 7.32447947 ERB

Standard deviation: 146.7 Hz = 95.09 Mel = 9.6 semitones = 2.604 ERB

Mean absolute slope: 802.8 Hz/s = 521.8 Mel/s = 54.18 semitones/s = 14.33 ERB/s

Mean absolute slope without octave jumps: 24.55 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Senchurutti

Time domain:

Start time: 0 seconds

End time: 451.22501133786847 seconds

Total duration: 451.22501133786847 seconds

Time sampling:

Number of time slices (frames): 225608

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.0055056689342402815 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

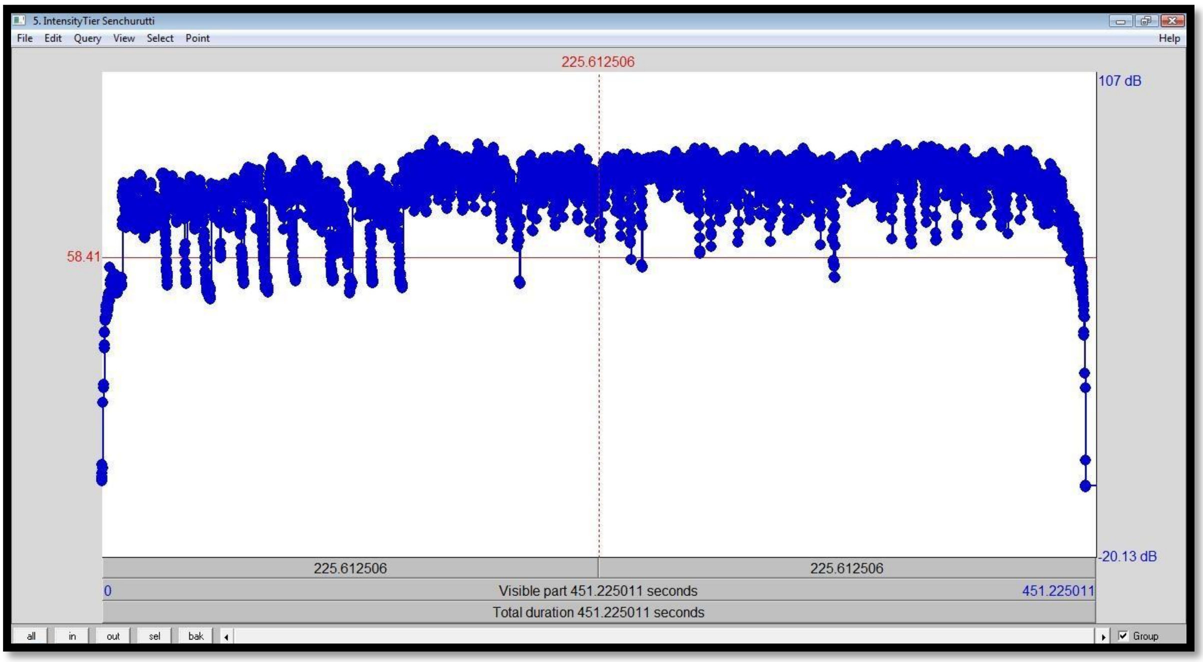
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peak)

Object name: Senchurutti

Domain:

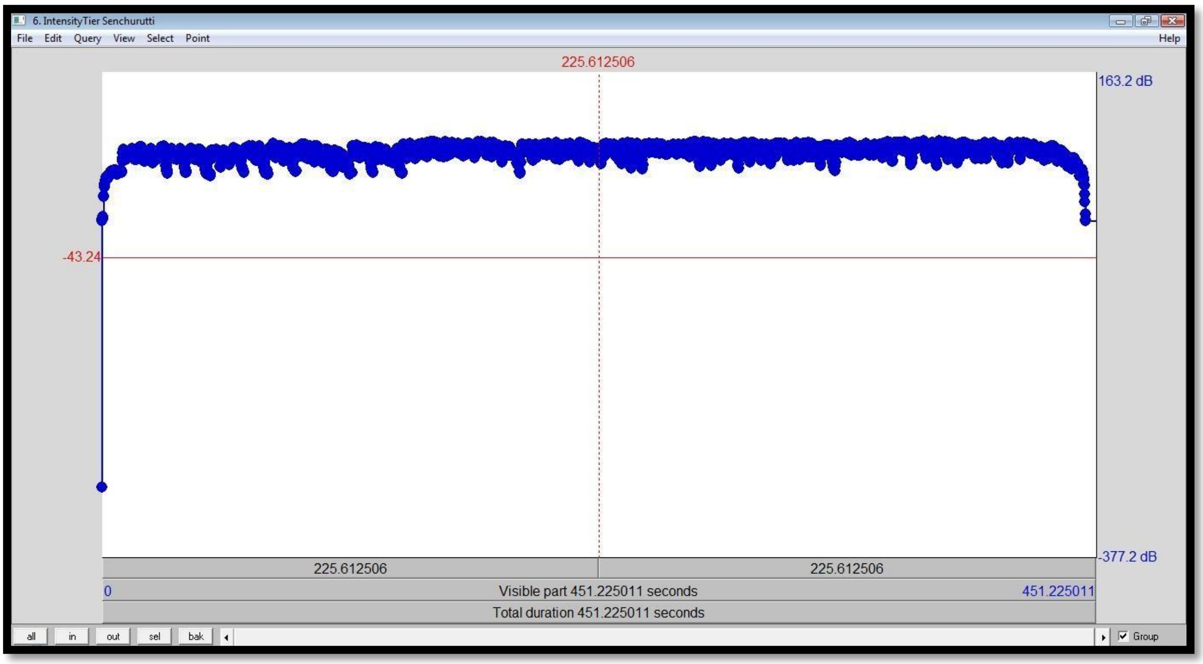
xmin: 0

xmax: 451.22501133786847

Number of points: 7045

Minimum value: -1.9773146654697733

Maximum value: 88.80299780682346



Object type: IntensityTier (Valleys)

Object name: Senchurutti

Domain:

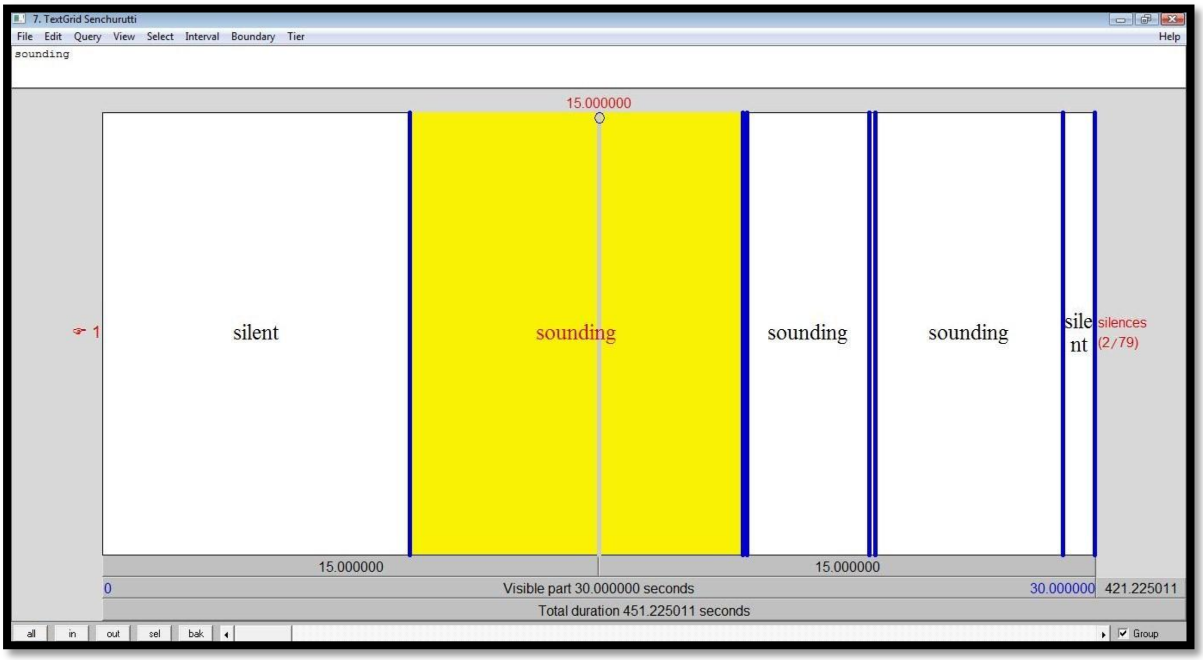
xmin: 0

xmax: 451.22501133786847

Number of points: 7045

Minimum value: -300

Maximum value: 85.99564850216478



Object type: TextGrid (Silence)

Object name: Senchurutti

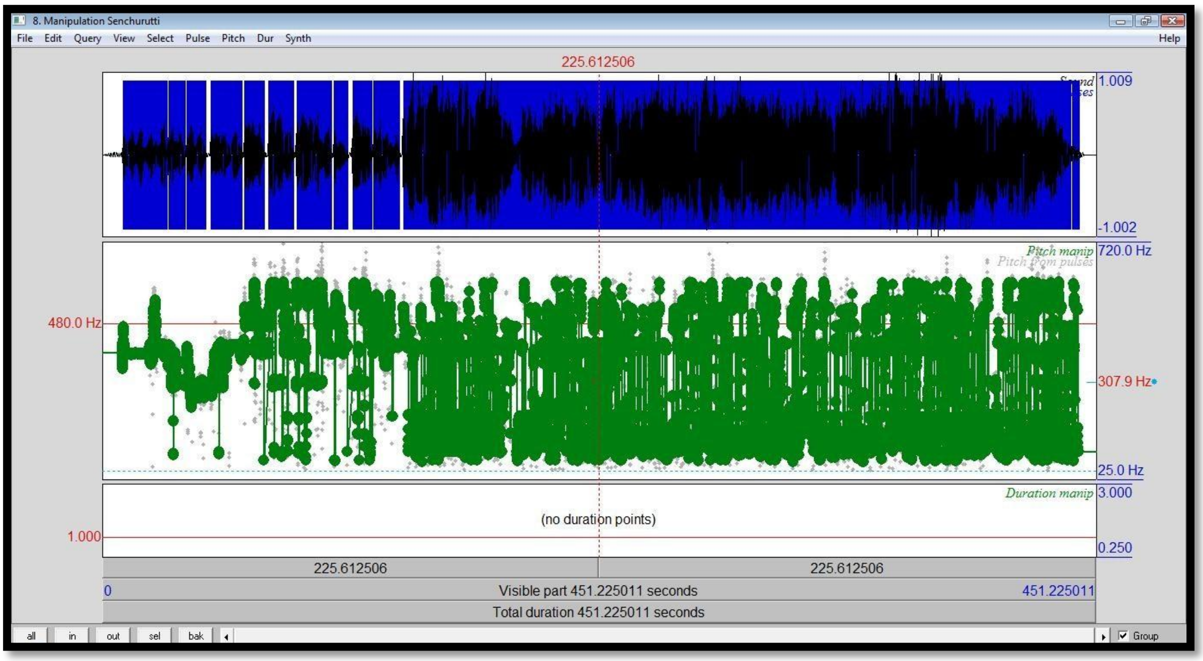
Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 79

Number of points: 0

6. Manipulation



Object type: Manipulation

Object name: Senchurutti

Domain:

xmin: 0

xmax: 451.22501133786847

Editor type: ManipulationEditor

Editor name: 8. Manipulation Senchurutti

Data type: Manipulation

Data name: Senchurutti

Editor start: 0 seconds

Editor end: 451.22501133786847 seconds

Window start: 0 seconds

Window end: 451.22501133786847 seconds

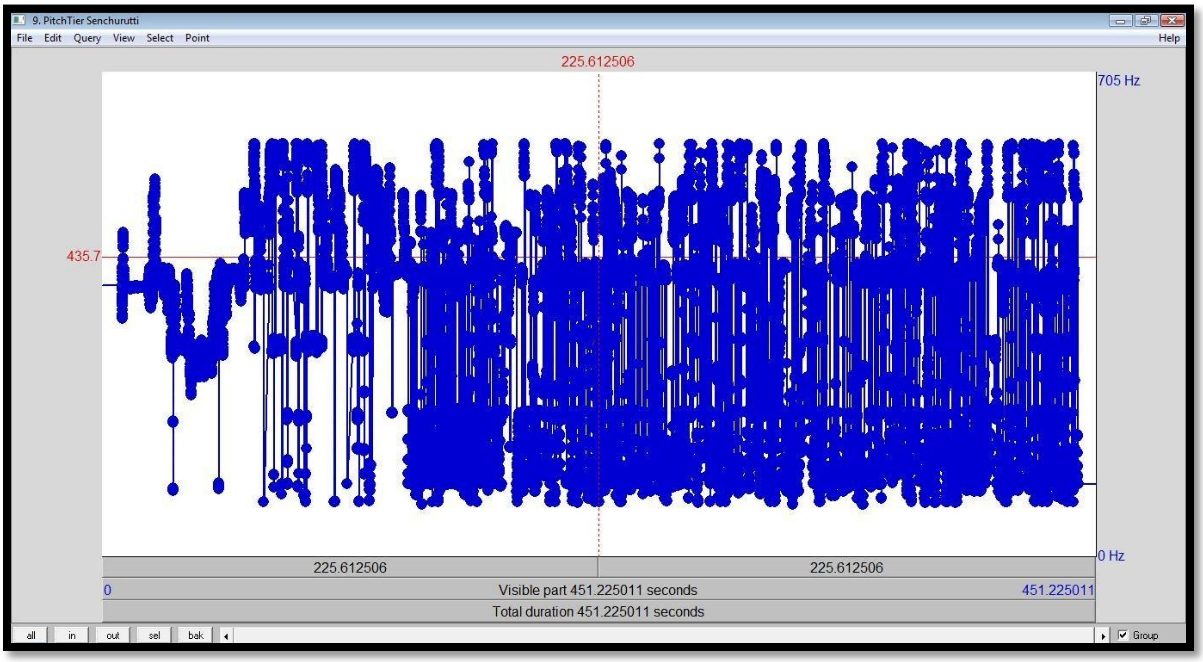
Selection start: 225.61250566893423 seconds

Selection end: 225.61250566893423 seconds

Arrow scroll step: 0.05 seconds

Group: yes

7. Pitch Tier



Object type: PitchTier

Object name: Senchurutti

Time domain:

Start time: 0 seconds

End time: 451.22501133786847 seconds

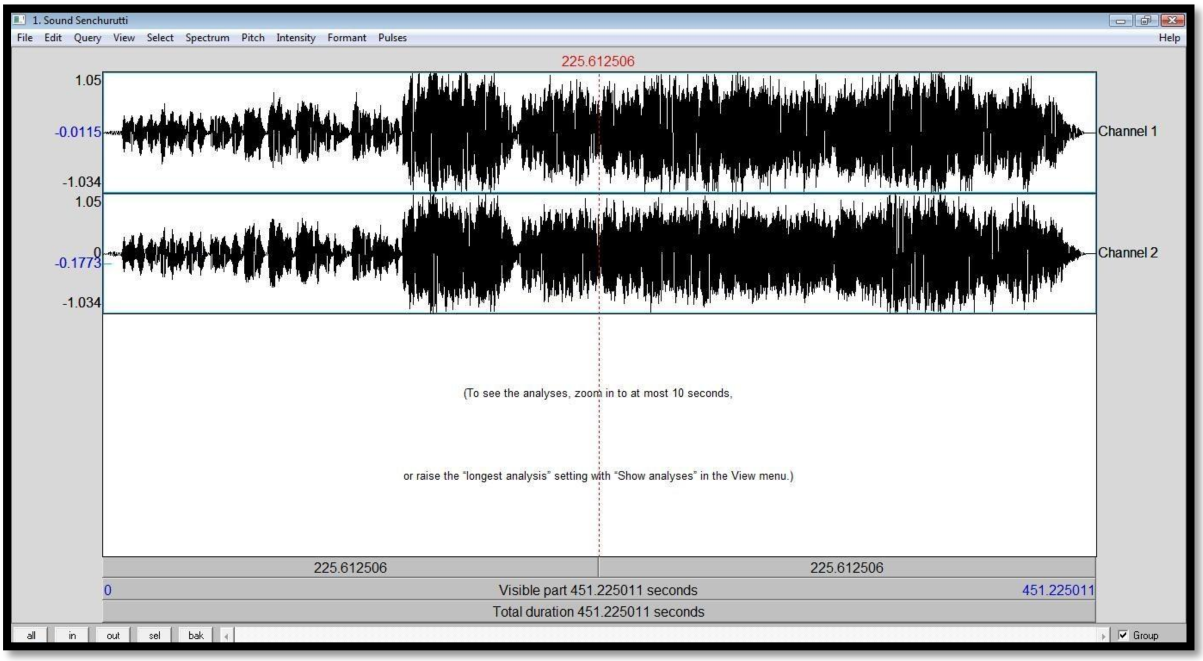
Total duration: 451.22501133786847 seconds

Number of points: 40524

Minimum pitch value: 75.01870320683106 Hz

Maximum pitch value: 599.9902185738799 Hz

8. Visible Sound



Editor type: SoundEditor

Editor name: Sound Senchurutti

Data type: Sound

Data name: Senchurutti

Editor start: 0 seconds

Editor end: 451.22501133786847 seconds

Window start: 0 seconds

Window end: 451.22501133786847 seconds

Selection start: 225.61250566893423 seconds

Selection end: 225.61250566893423 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

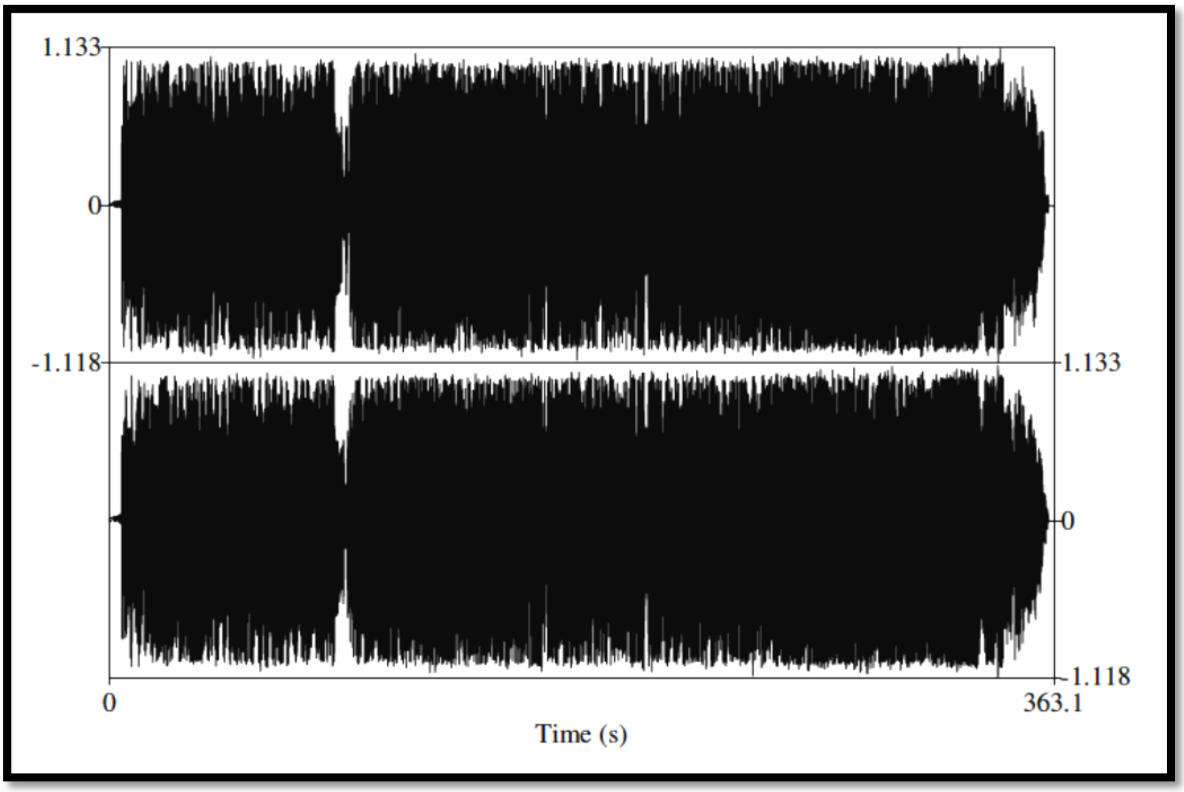
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Brindavani Ragam (Track 7)

1. **Sound Draw**



Object type: Sound

Object name: Brindavani

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 363.1139909297052 seconds

Total duration: 363.1139909297052 seconds

Time sampling:

Number of samples: 16013327

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.11824372 Pascal

Maximum: 1.13272249 Pascal

Mean: 0.0171576855 Pascal

Root-mean-square: 0.303818828 Pascal

Total energy: 33.5175565 Pascal^2 sec (energy in air: 0.0837938913 Joule/m^2)

Mean power (intensity) in air: 0.0002307647 Watt/m^2 = 83.63 dB

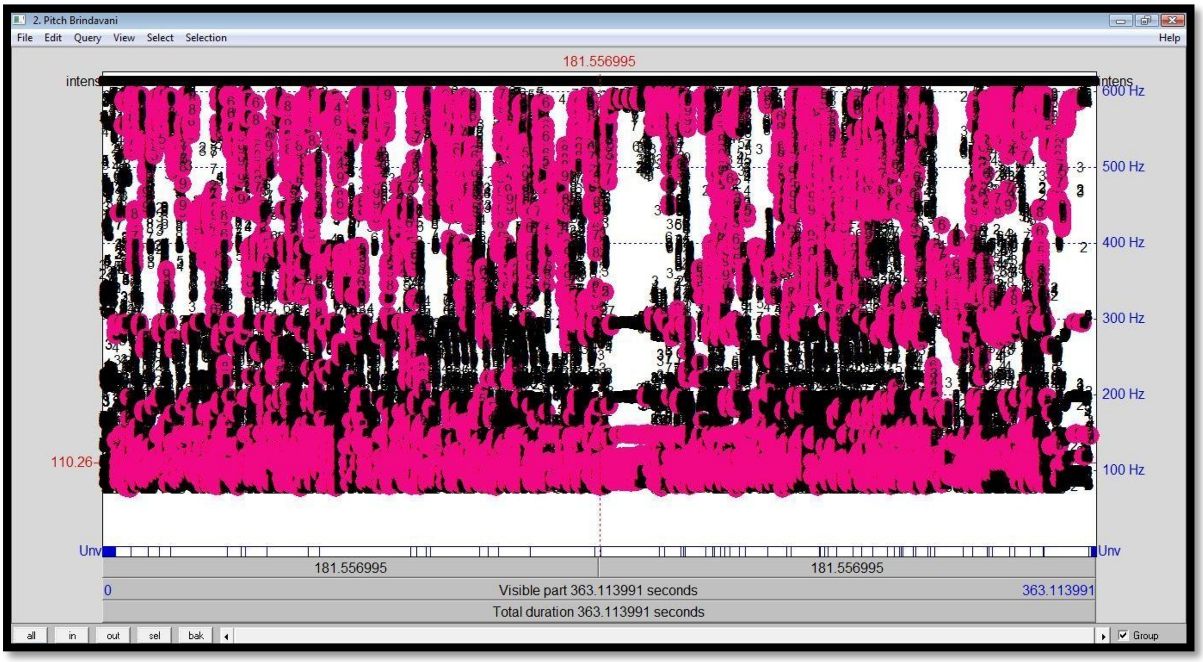
Standard deviation in channel 1: 0.301947603 Pascal

Standard deviation in channel 2: 0.304704936 Pascal

2. **Query**

- Total Duration: 363.1139909297052 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 16013327 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: 0.01726145025252664 Pascal
- Time of Minimum (Interpolation at Sinc70): 341.69057949496806 seconds
- Time of Maximum (Interpolation at Sinc70): 326.71437704907135 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.1407066183667174 Pascal
- Nearest zero crossing: 0.07502650215006561 seconds
- Mean: 0.01715768554630508 Pascal
- Root mean square: 0.3038188278912955 Pascal
- Standard Deviation: 0.3033294026992157 Pascal
- Energy: 33.51755653888947 Pa2 sec
- Power: 0.09230588018124064 Pa2
- Energy in Air: 0.08379389134722368 Joule/m2
- Power in Air: 0.00023076470045310158 Watt/m2
- Intensity: 83.63169376533521 dB

3. Periodicity



Object type: Pitch

Object name: Brindavani

Time domain:

Start time: 0 seconds

End time: 363.1139909297052 seconds

Total duration: 363.1139909297052 seconds

Time sampling:

Number of frames: 36308 (33186 voiced)

Time step: 0.01 seconds

First frame centred at: 0.0219954648526012 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 92.345916 Hz = 85.3647797 Mel = -1.37855923 semitones above 100 Hz = 2.80764297 ERB

16% = 97.8086793 Hz = 90.0224196 Mel = -0.383587227 semitones above 100 Hz = 2.95341088 ERB

50% = 146.471781 Hz = 129.85995 Mel = 6.60747296 semitones above 100 Hz = 4.1700557 ERB

84% = 516.927309 Hz = 364.440915 Mel = 28.4395371 semitones above 100 Hz =

10.5096415 ERB

90% = 557.538971 Hz = 384.987576 Mel = 29.7488718 semitones above 100 Hz = 11.0140998 ERB

Estimated spreading:

84%-median = 370.5 Hz = 234.6 Mel = 21.83 semitones = 6.34 ERB

median-16% = 48.66 Hz = 39.84 Mel = 6.991 semitones = 1.217 ERB

90%-10% = 465.2 Hz = 299.6 Mel = 31.13 semitones = 8.207 ERB

Minimum 74.9909573 Hz = 70.3003967 Mel = -4.98253745 semitones above 100 Hz = 2.33075216 ERB

Maximum 599.972826 Hz = 405.666422 Mel = 31.0187659 semitones above 100 Hz = 11.515254 ERB

Range 525 Hz = 335.366026 Mel = 36 semitones = 9.185 ERB

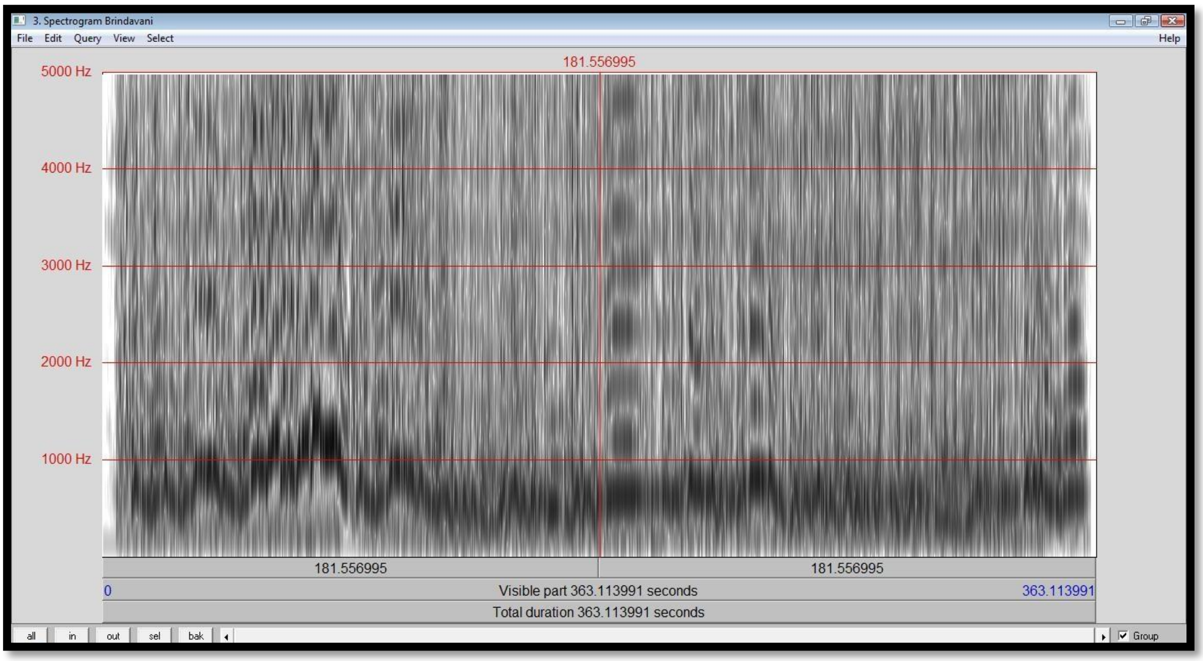
Average: 247.982808 Hz = 192.01944 Mel = 11.4155396 semitones above 100 Hz = 5.81421438 ERB

Standard deviation: 178.6 Hz = 115.6 Mel = 12.01 semitones = 3.17 ERB

Mean absolute slope: 955.6 Hz/s = 633.8 Mel/s = 72.29 semitones/s = 17.63 ERB/s

Mean absolute slope without octave jumps: 32.2 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Brindavani

Time domain:

Start time: 0 seconds

End time: 363.1139909297052 seconds

Total duration: 363.1139909297052 seconds

Time sampling:

Number of time slices (frames): 181552

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005995464852607651 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

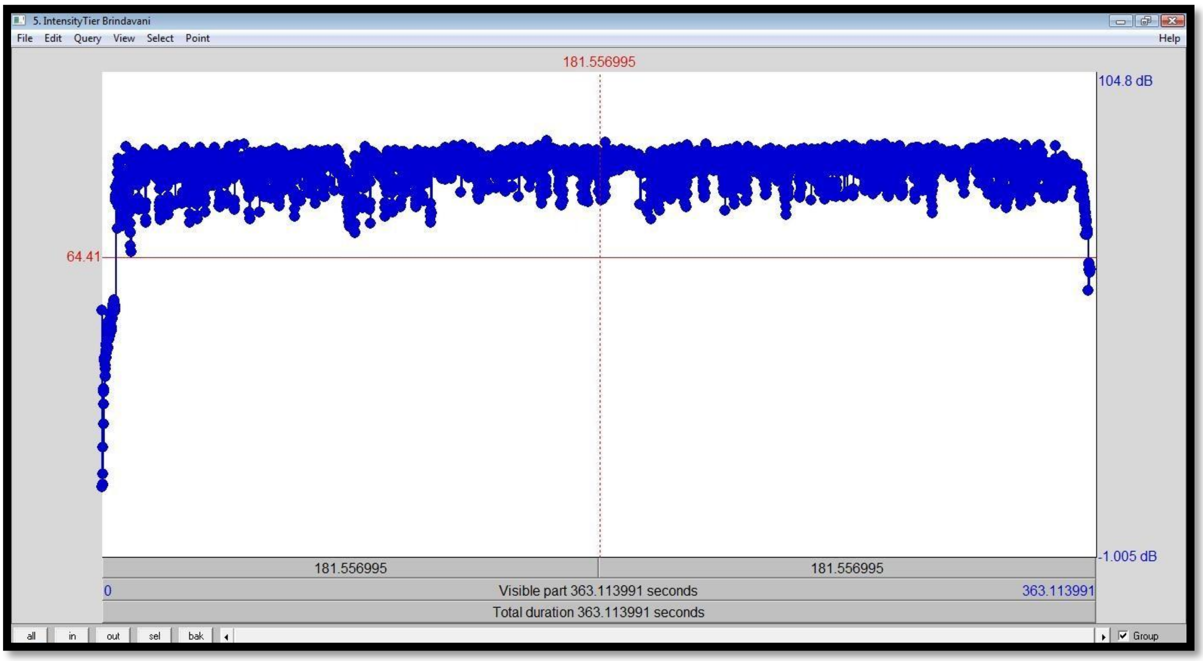
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier

Object name: Brindavani

Domain:

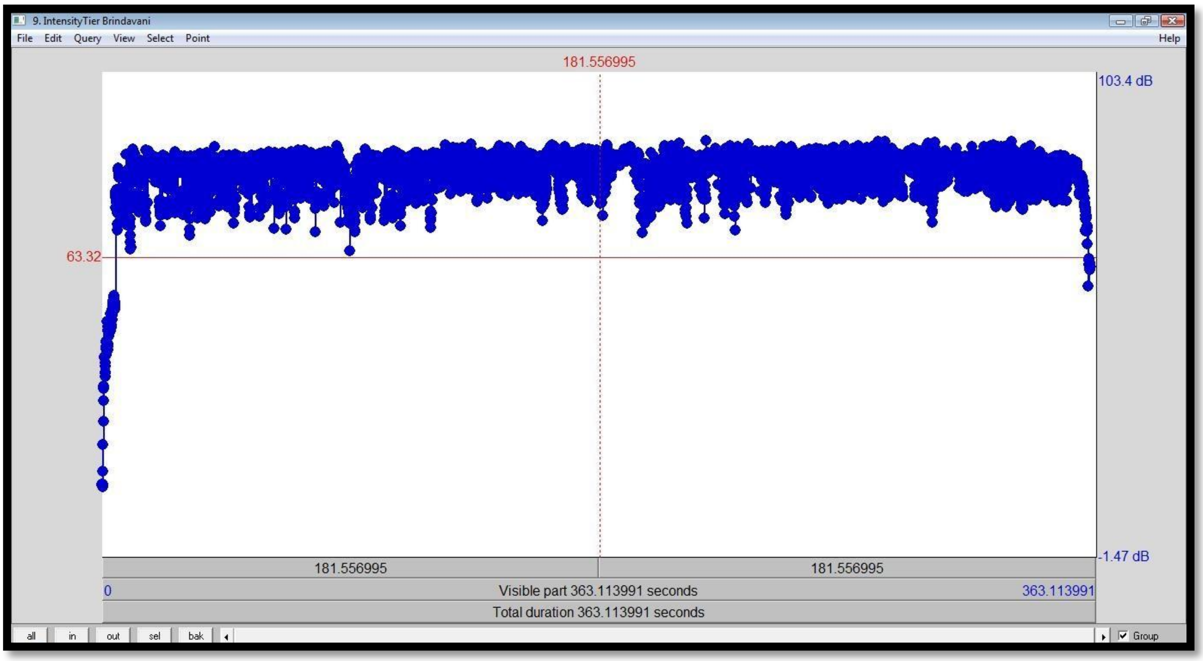
xmin: 0

xmax: 363.1139909297052

Number of points: 6427

Minimum value: 14.116500590637026

Maximum value: 89.72179454923307



Object type: IntensityTier

Object name: Brindavani

Domain:

xmin: 0

xmax: 363.1139909297052

Number of points: 6426

Minimum value: 13.506483392078398

Maximum value: 88.39041736017592

Object type: TextGrid (Silence)

Object name: Brindavani

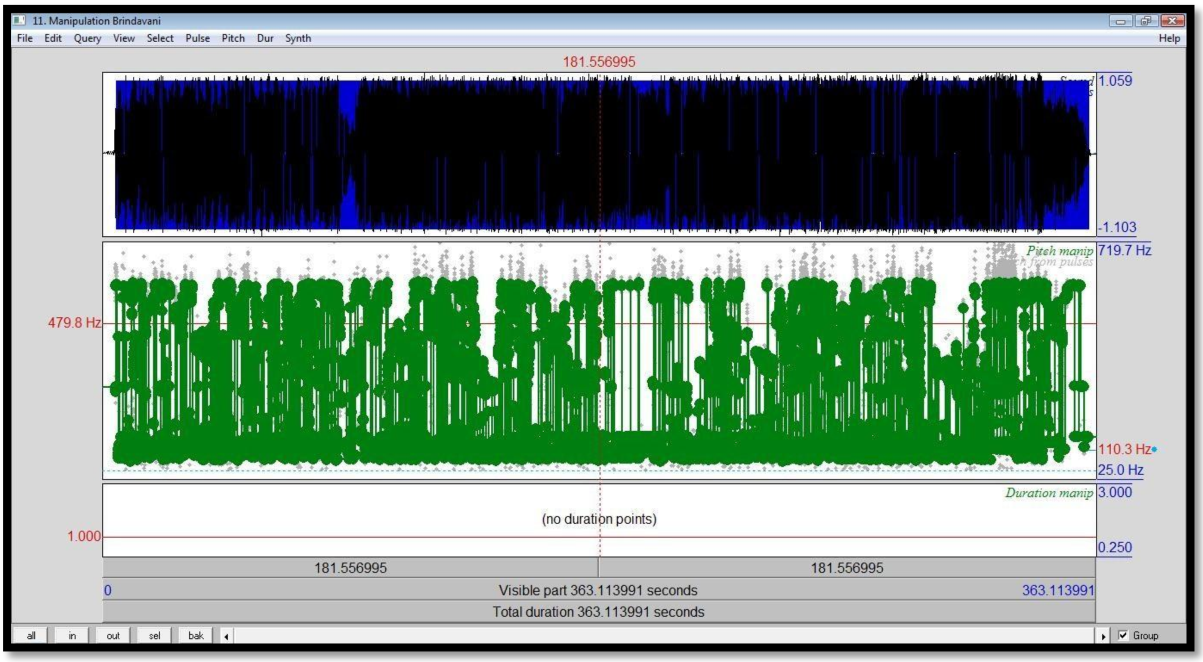
Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 3

Number of points: 0

6. Manipulation



Object type: Manipulation

Object name: Brindavani

Domain:

xmin: 0

xmax: 363.1139909297052

Editor type: ManipulationEditor

Editor name: 11. Manipulation Brindavani

Data type: Manipulation

Data name: Brindavani

Editor start: 0 seconds

Editor end: 363.1139909297052 seconds

Window start: 0 seconds

Window end: 363.1139909297052 seconds

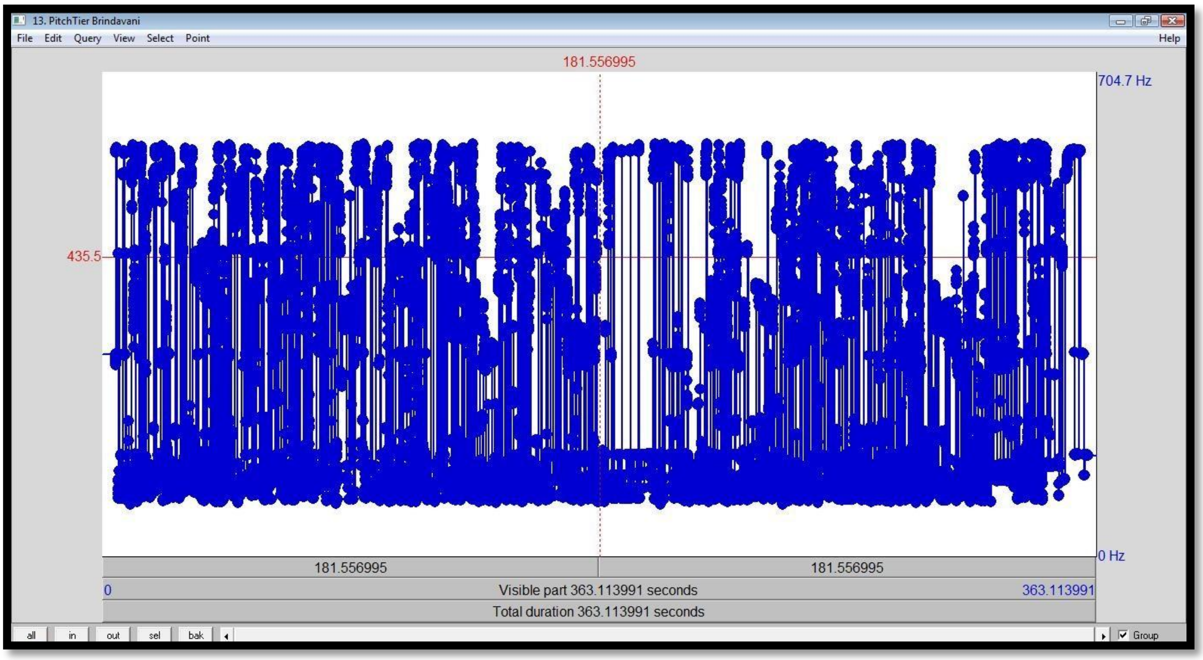
Selection start: 181.5569954648526 seconds

Selection end: 181.5569954648526 seconds

Arrow scroll step: 0.05 seconds

Group: yes

7. Pitch Tier



Object type: PitchTier

Object name: Brindavani

Time domain:

Start time: 0 seconds

End time: 363.1139909297052 seconds

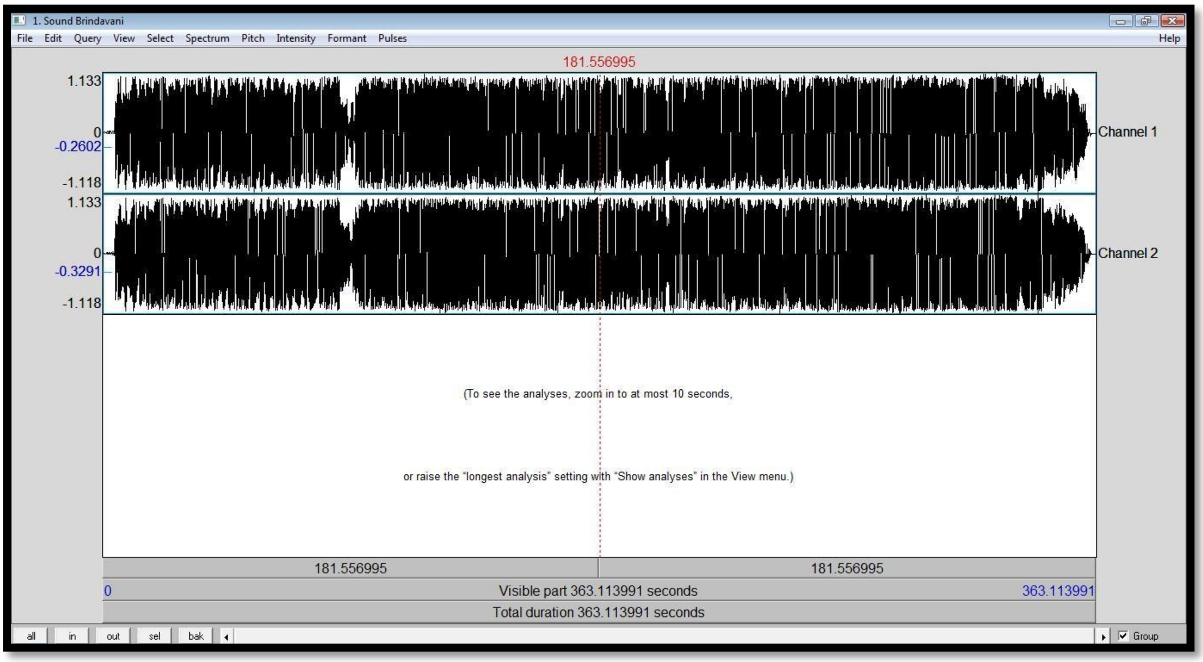
Total duration: 363.1139909297052 seconds

Number of points: 33258

Minimum pitch value: 75.02303674325992 Hz

Maximum pitch value: 599.7661817763299 Hz

8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Brindavani

Data type: Sound

Data name: Brindavani

Editor start: 0 seconds

Editor end: 363.1139909297052 seconds

Window start: 0 seconds

Window end: 363.1139909297052 seconds

Selection start: 181.5569954648526 seconds

Selection end: 181.5569954648526 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

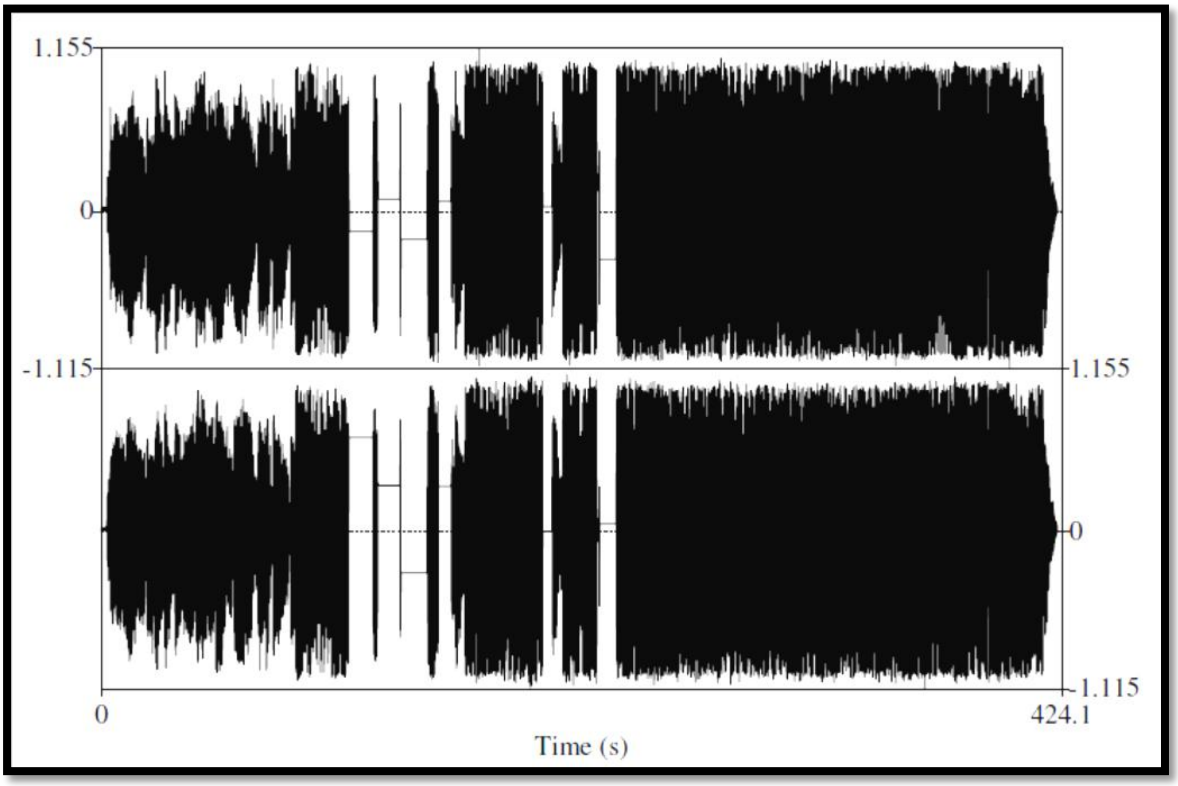
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Mohanam / Bhoop Ragam (Track 8)

1. **Sound Draw**



Object type: Sound

Object name: Mohanam_Bhoop

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 424.0837868480726 seconds

Total duration: 424.0837868480726 seconds

Time sampling:

Number of samples: 18702095

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.11455508 Pascal

Maximum: 1.15485533 Pascal

Mean: 0.020288942 Pascal

Root-mean-square: 0.29311742 Pascal

Total energy: 36.4363552 Pascal^2 sec (energy in air: 0.091090888 Joule/m^2)

Mean power (intensity) in air: 0.000214794554 Watt/m^2 = 83.32 dB

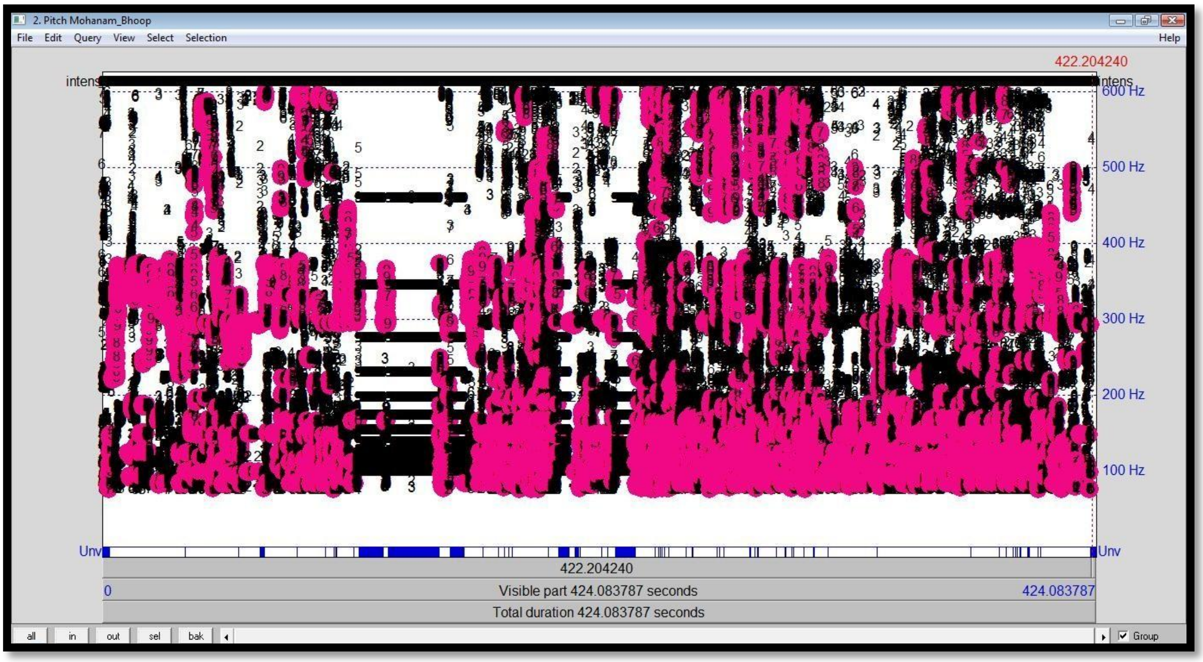
Standard deviation in channel 1: 0.281478937 Pascal

Standard deviation in channel 2: 0.30187965 Pascal

2. **Query**

- Total Duration: 424.0837868480726 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 18702095 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: 0.021383411070389657 Pascal
- Time of Minimum (Interpolation at Sinc70): 208.4067535806835 seconds
- Time of Maximum (Interpolation at Sinc70): 166.81574470399394 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.1570487590135508 Pascal
- Nearest zero crossing: 0.07459205893524942 seconds
- Mean: 0.02028894200277821 Pascal
- Root mean square: 0.2931174197107973 Pascal
- Standard Deviation: 0.29185759823517465 Pascal
- Energy: 36.436355200352935 Pa2 sec
- Power: 0.08591782173791569 Pa2
- Energy in Air: 0.09109088800088235 Joule/m2
- Power in Air: 0.00021479455434478923 Watt/m2
- Intensity: 83.32023266562024 dB

3. Periodicity



Object type: Pitch

Object name: Mohanam_Bhoop

Time domain:

Start time: 0 seconds

End time: 424.0837868480726 seconds

Total duration: 424.0837868480726 seconds

Time sampling:

Number of frames: 42405 (34155 voiced)

Time step: 0.01 seconds

First frame centred at: 0.0218934240362843 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 83.6072746 Hz = 77.831074 Mel = -3.09959543 semitones above 100 Hz = 2.57020203 ERB

16% = 93.0703886 Hz = 85.98475 Mel = -1.24327037 semitones above 100 Hz = 2.82709072 ERB

50% = 146.521956 Hz = 129.899571 Mel = 6.61340239 semitones above 100 Hz = 4.17124027 ERB

84% = 331.700763 Hz = 259.563947 Mel = 20.758588 semitones above 100 Hz =

7.82174639 ERB

90% = 367.712951 Hz = 281.581506 Mel = 22.5429599 semitones above 100 Hz = 8.4030393 ERB

Estimated spreading:

84%-median = 185.2 Hz = 129.7 Mel = 14.15 semitones = 3.651 ERB

median-16% = 53.45 Hz = 43.92 Mel = 7.857 semitones = 1.344 ERB

90%-10% = 284.1 Hz = 203.8 Mel = 25.64 semitones = 5.833 ERB

Minimum 74.9444701 Hz = 70.2594859 Mel = -4.99327277 semitones above 100 Hz = 2.32944548 ERB

Maximum 599.891619 Hz = 405.627582 Mel = 31.0164225 semitones above 100 Hz = 11.5143187 ERB

Range 524.9 Hz = 335.368096 Mel = 36.01 semitones = 9.185 ERB

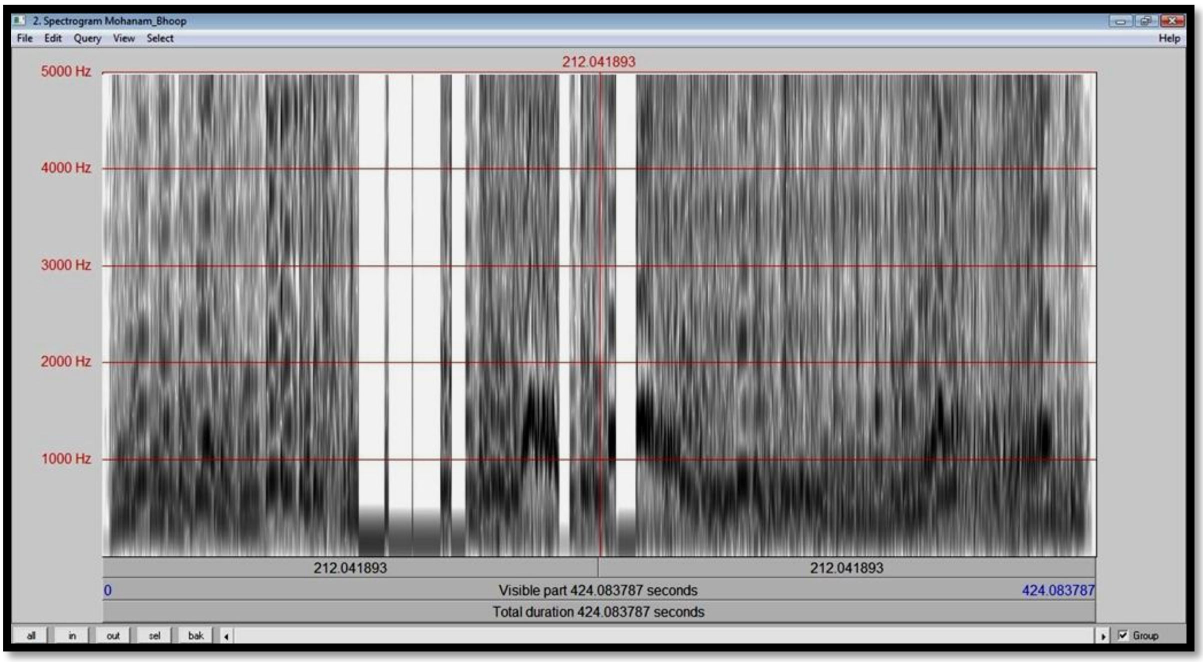
Average: 192.80703 Hz = 158.484488 Mel = 8.40886499 semitones above 100 Hz = 4.92195644 ERB

Standard deviation: 123.6 Hz = 84.16 Mel = 9.722 semitones = 2.362 ERB

Mean absolute slope: 532 Hz/s = 378.2 Mel/s = 49.55 semitones/s = 10.84 ERB/s

Mean absolute slope without octave jumps: 27.94 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Mohanam_Bhoop

Time domain:

Start time: 0 seconds

End time: 424.0837868480726 seconds

Total duration: 424.0837868480726 seconds

Time sampling:

Number of time slices (frames): 212037

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005893424036281105 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

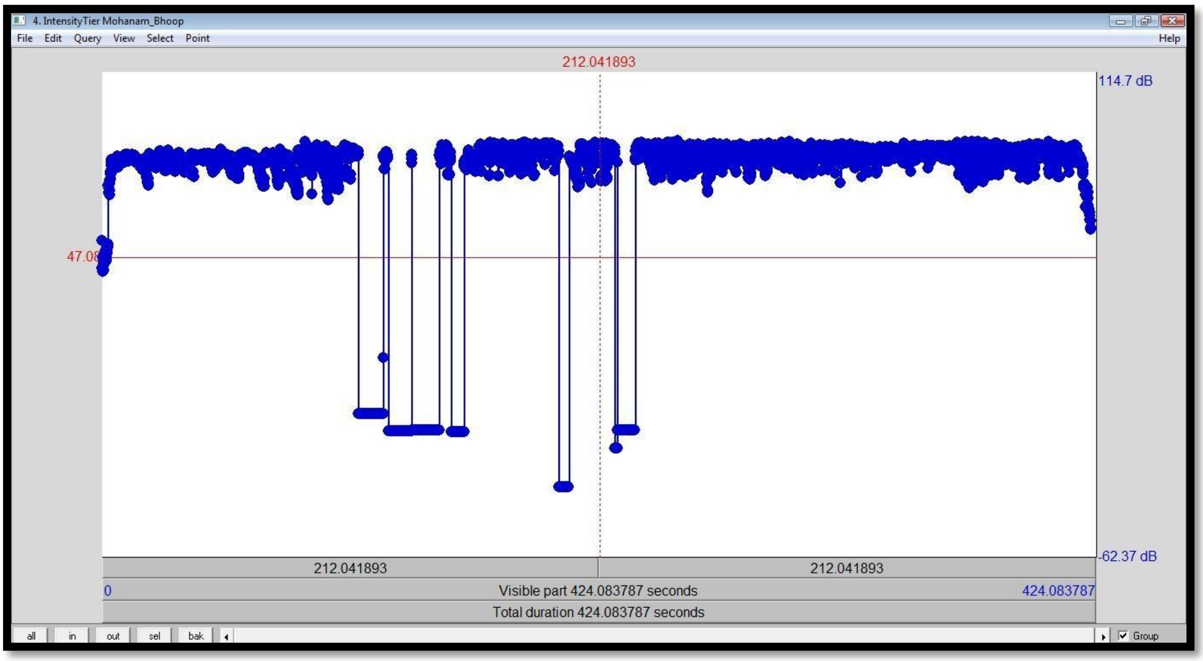
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peaks)

Object name: Mohanam_Bhoop

Domain:

xmin: 0

xmax: 424.0837868480726

Number of points: 9264

Minimum value: -37.066224963629296

Maximum value: 89.43474196115874

Object type: IntensityTier (Valleys)

Object name: Mohanam_Bhoop

Domain:

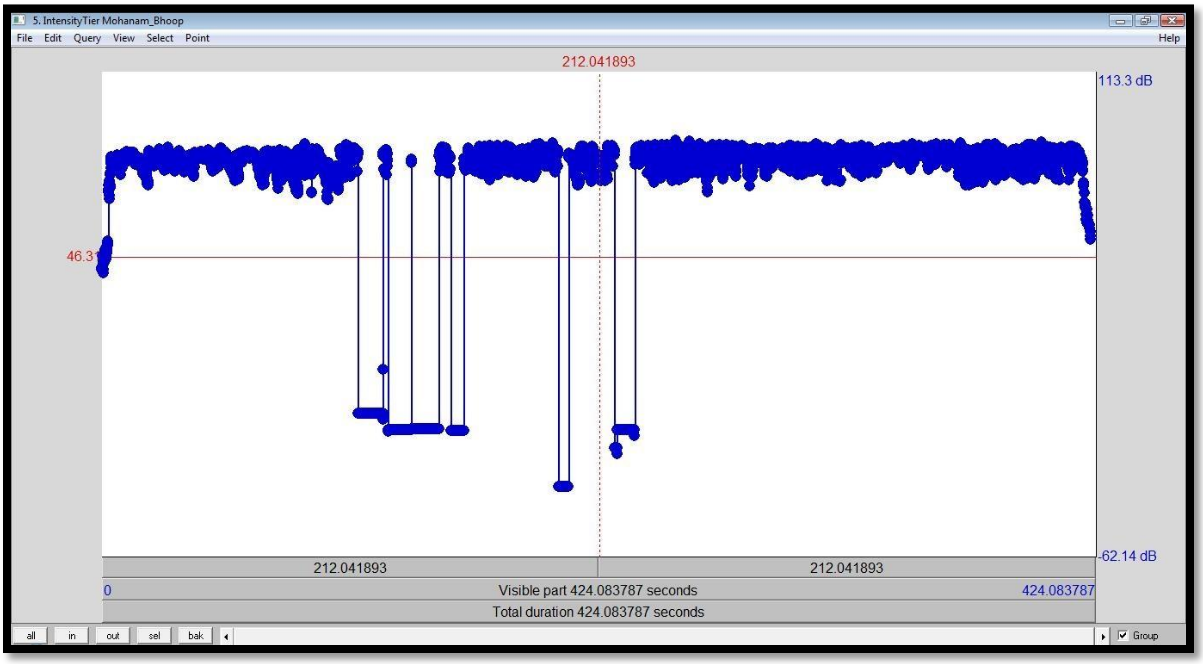
xmin: 0

xmax: 424.0837868480726

Number of points: 9263

Minimum value: -37.06626615796723

Maximum value: 88.27742890633311



Object type: TextGrid (Silent)

Object name: Mohanam_Bhoop

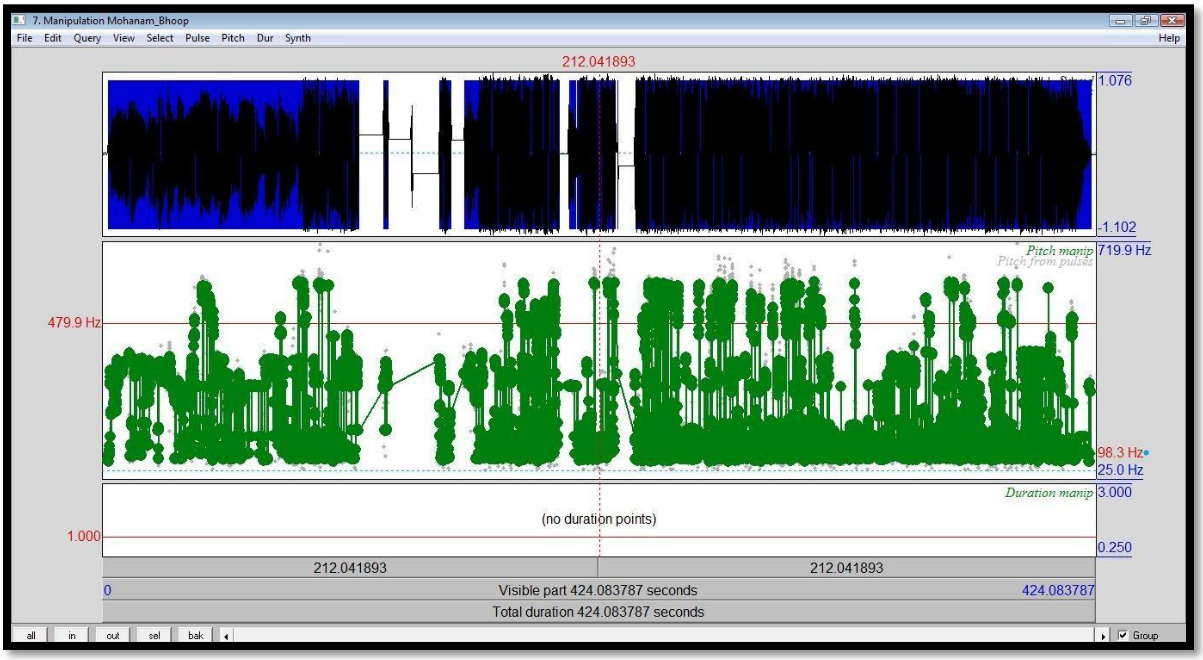
Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 19

Number of points: 0

6. Manipulation



Editor type: Manipulation Editor

Editor name: 7. Manipulation Mohanam_Bhoop

Data type: Manipulation

Data name: Mohanam_Bhoop

Editor start: 0 seconds

Editor end: 424.0837868480726 seconds

Window start: 0 seconds

Window end: 424.0837868480726 seconds

Selection start: 212.0418934240363 seconds

Selection end: 212.0418934240363 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Object type: Manipulation

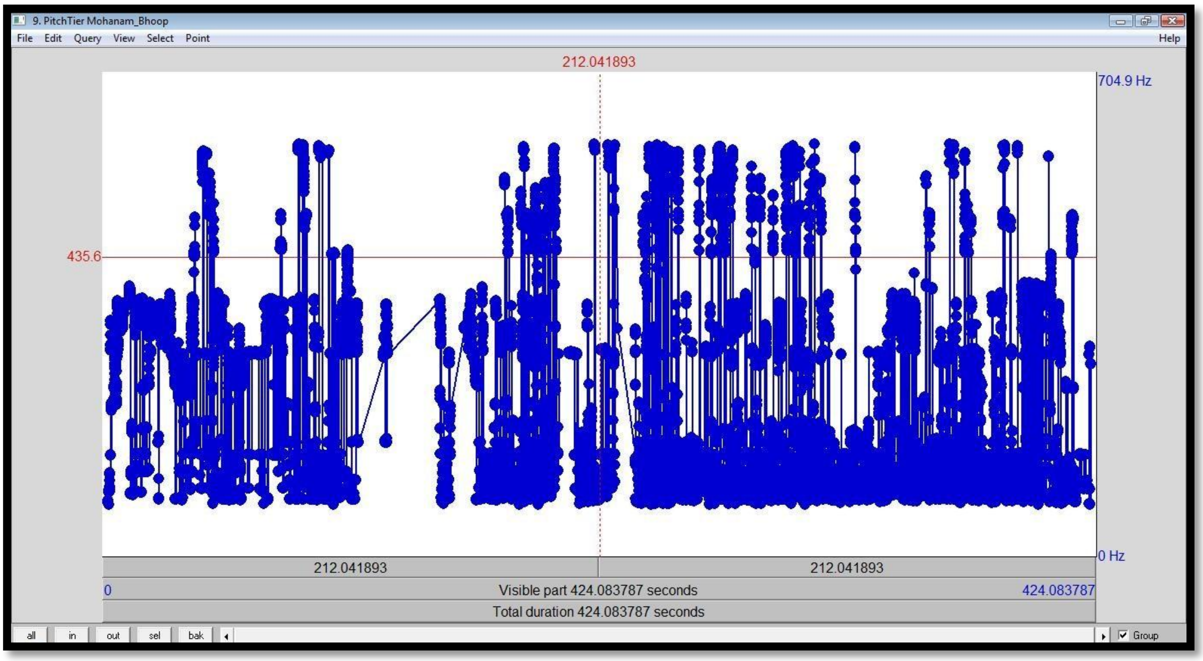
Object name: Mohanam_Bhoop

Domain:

xmin: 0

xmax: 424.0837868480726

7. Pitch Tier



Object type: PitchTier

Object name: Mohanam_Bhoop

Time domain:

Start time: 0 seconds

End time: 424.0837868480726 seconds

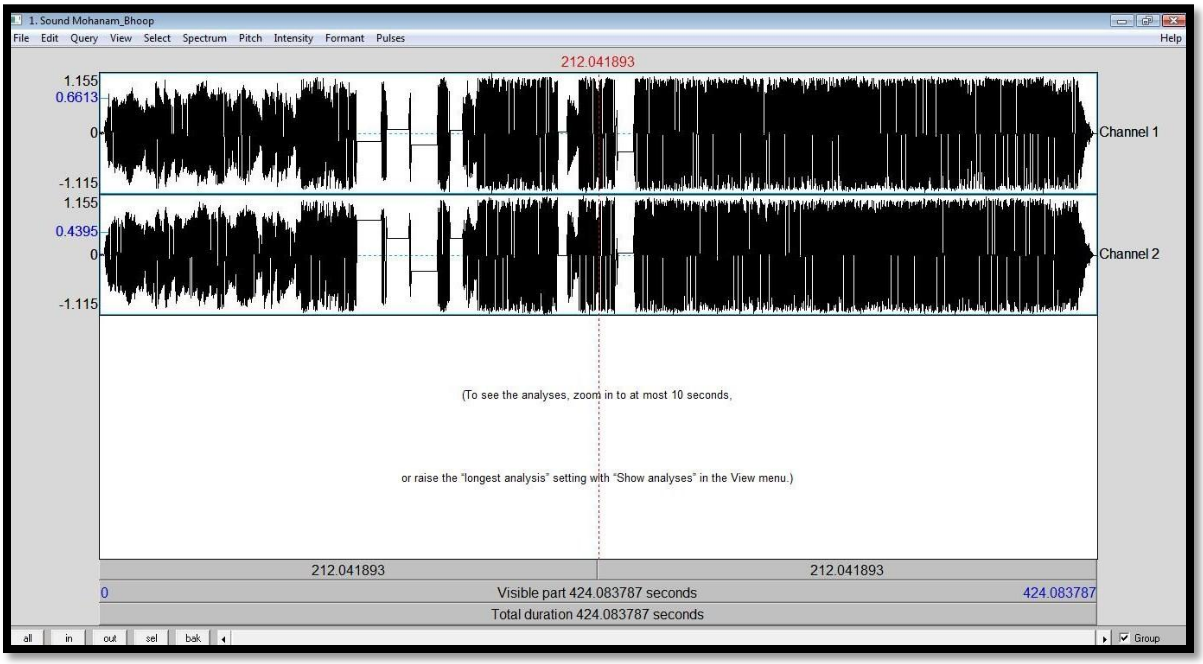
Total duration: 424.0837868480726 seconds

Number of points: 34689

Minimum pitch value: 74.96811789181474 Hz

Maximum pitch value: 599.9012989625862 Hz

8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Mohanam_Bhoop

Data type: Sound

Data name: Mohanam_Bhoop

Editor start: 0 seconds

Editor end: 424.0837868480726 seconds

Window start: 0 seconds

Window end: 424.0837868480726 seconds

Selection start: 212.0418934240363 seconds

Selection end: 212.0418934240363 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

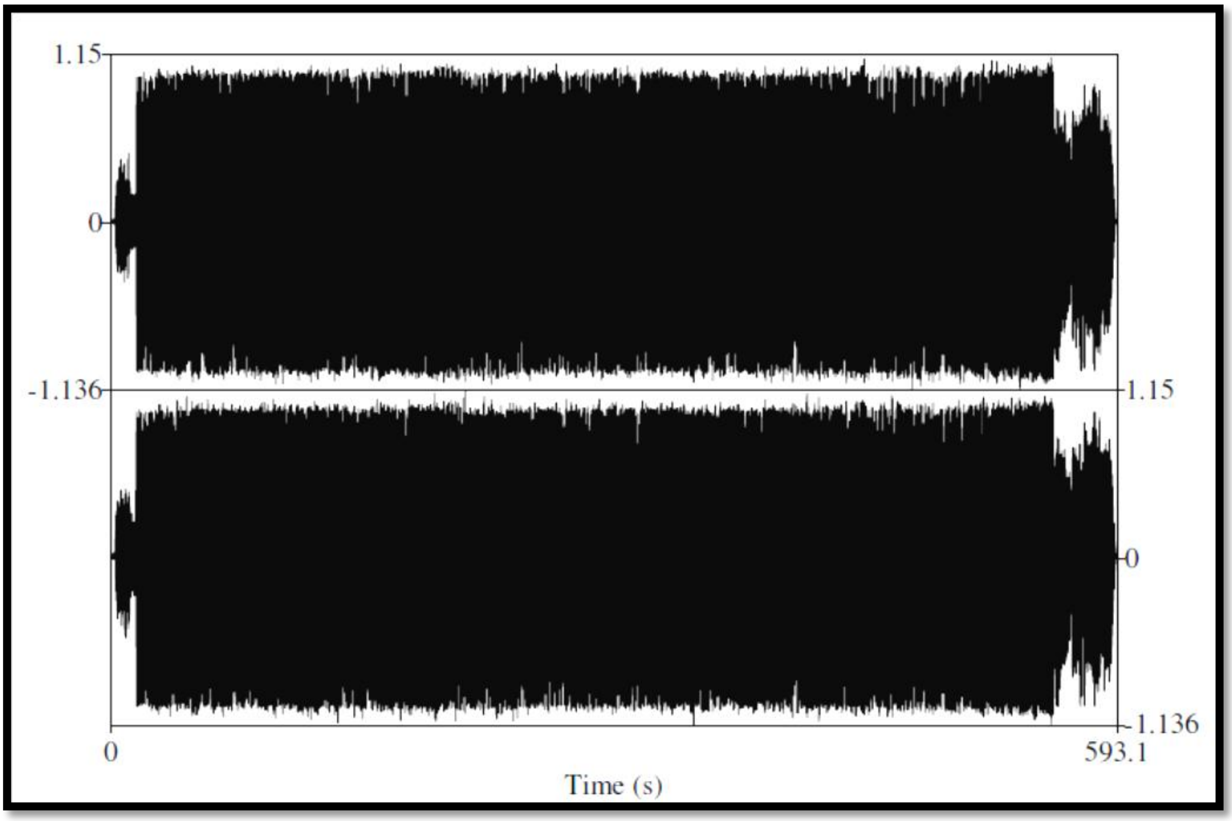
Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

Identification of Waveform, Intensity, Sprectrogram, pitch and duration of Darbari Kanada Ragam (Track 9)

1. **Sound Draw**



Object type: Sound

Object name: Darbari_Kanada

Number of channels: 2 (stereo)

Time domain:

Start time: 0 seconds

End time: 593.0960317460317 seconds

Total duration: 593.0960317460317 seconds

Time sampling:

Number of samples: 26155535

Sampling period: 2.2675736961451248e-005 seconds

Sampling frequency: 44100 Hz

First sample centred at: 1.1337868480725624e-005 seconds

Amplitude:

Minimum: -1.1364997 Pascal

Maximum: 1.15039433 Pascal

Mean: 0.017268702 Pascal

Root-mean-square: 0.32672525 Pascal

Total energy: 63.3126391 Pascal² sec (energy in air: 0.158281598 Joule/m²)

Mean power (intensity) in air: 0.000266873473 Watt/m² = 84.26 dB

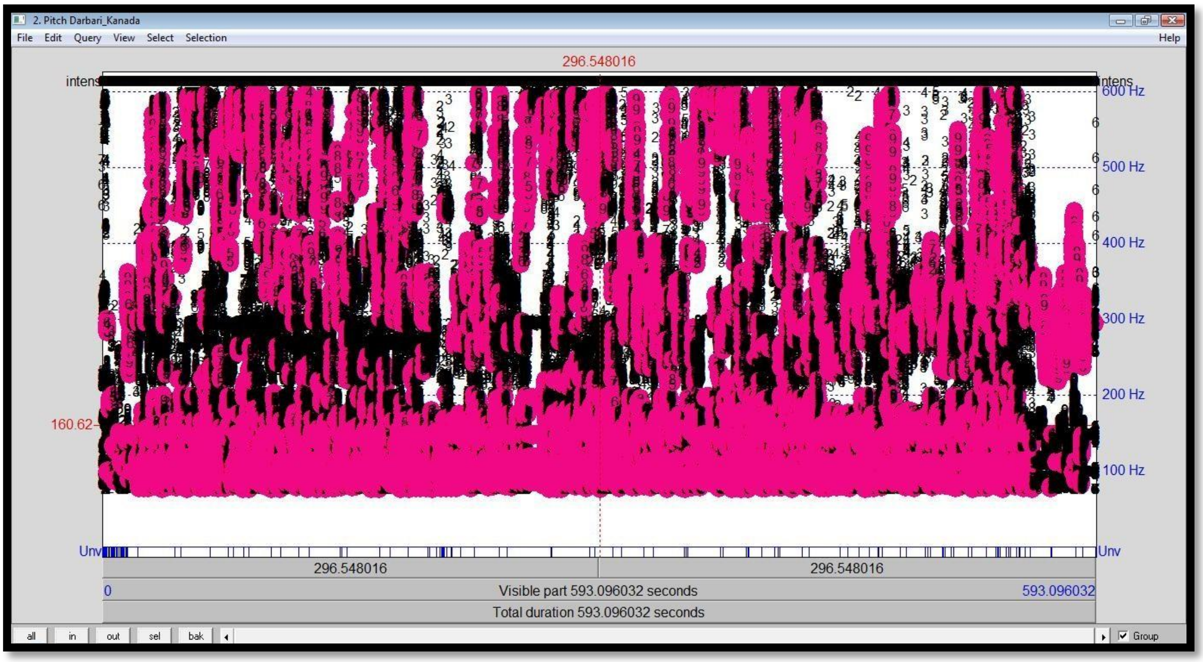
Standard deviation in channel 1: 0.323842243 Pascal

Standard deviation in channel 2: 0.328668602 Pascal

2. Query

- Total Duration: 593.0960317460317 seconds
- Number of Channels: 2 channels (stereo)
- Number of Sampling: 26155535 samples
- Sampling Period: 2.2675736961451248e-005 seconds
- Sampling Frequency: 44100 Hz
- Sample number from time: 22050.5
- Sound Value at time: 0.015707215513165448 Pascal
- Time of Minimum (Interpolation at Sinc70): 191.88204220629473 seconds
- Time of Maximum (Interpolation at Sinc70): 191.04963856940603 seconds
- Absolute Extremum (Interpolation at Sinc70): 1.154943603771059 Pascal
- Nearest zero crossing: 0.07475094143504606 seconds
- Mean: 0.01726870203417207 Pascal
- Root mean square: 0.32672525022683097 Pascal
- Standard Deviation: 0.32626434698673007 Pascal
- Energy: 63.31263908774723 Pa2 sec
- Power: 0.10674938913578531 Pa2
- Energy in Air: 0.15828159771936806 Joule/m2
- Power in Air: 0.0002668734728394633 Watt/m2
- Intensity: 84.26305407163324 dB

3. Periodicity



Object type: Pitch

Object name: Darbari_Kanada

Time domain:

Start time: 0 seconds

End time: 593.0960317460317 seconds

Total duration: 593.0960317460317 seconds

Time sampling:

Number of frames: 59306 (53294 voiced)

Time step: 0.01 seconds

First frame centred at: 0.023015873015850254 seconds

Ceiling at: 600 Hz

Estimated quantiles:

10% = 87.4610703 Hz = 81.1662119 Mel = -2.31944509 semitones above 100 Hz = 2.67557229 ERB

16% = 89.8522256 Hz = 83.2254357 Mel = -1.85248627 semitones above 100 Hz = 2.74042756 ERB

50% = 140.379985 Hz = 125.028129 Mel = 5.87204709 semitones above 100 Hz = 4.02523347 ERB

84% = 334.271421 Hz = 261.165176 Mel = 20.8922402 semitones above 100 Hz =

7.86435301 ERB

90% = 424.41897 Hz = 314.557698 Mel = 25.0258697 semitones above 100 Hz = 9.25606203 ERB

Estimated spreading:

84%-median = 193.9 Hz = 136.1 Mel = 15.02 semitones = 3.839 ERB

median-16% = 50.53 Hz = 41.8 Mel = 7.725 semitones = 1.285 ERB

90%-10% = 337 Hz = 233.4 Mel = 27.35 semitones = 6.581 ERB

Minimum 74.9400613 Hz = 70.2556058 Mel = -4.99429124 semitones above 100 Hz = 2.32932155 ERB

Maximum 599.028466 Hz = 405.214576 Mel = 30.9914947 semitones above 100 Hz = 11.5043717 ERB

Range 524.1 Hz = 334.95897 Mel = 35.99 semitones = 9.175 ERB

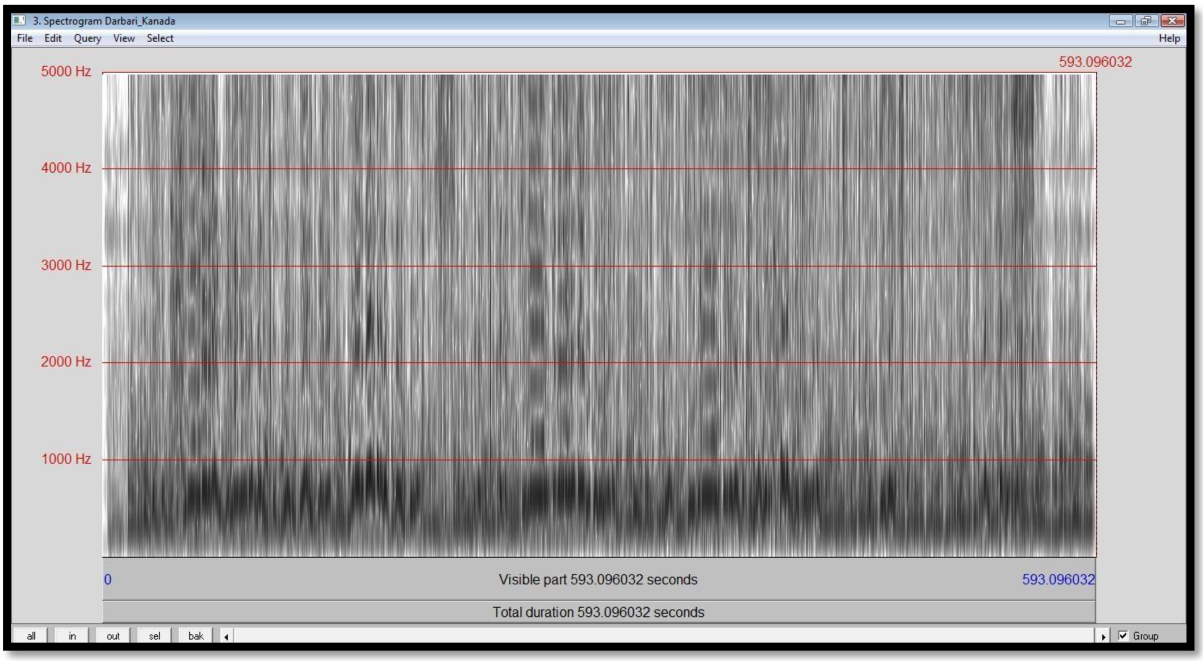
Average: 193.970037 Hz = 157.980103 Mel = 8.06214691 semitones above 100 Hz = 4.89202797 ERB

Standard deviation: 137.2 Hz = 91.67 Mel = 10.26 semitones = 2.552 ERB

Mean absolute slope: 741 Hz/s = 516.8 Mel/s = 66.64 semitones/s = 14.72 ERB/s

Mean absolute slope without octave jumps: 36.69 semitones/s

4. Spectrum



Object type: Spectrogram

Object name: Darbari_Kanada

Time domain:

Start time: 0 seconds

End time: 593.0960317460317 seconds

Total duration: 593.0960317460317 seconds

Time sampling:

Number of time slices (frames): 296544

Time step (frame distance): 0.002 seconds

First time slice (frame centre) at: 0.005015873015872912 seconds

Frequency domain:

Lowest frequency: 0 Hz

Highest frequency: 5000 Hz

Total bandwidth: 5000 Hz

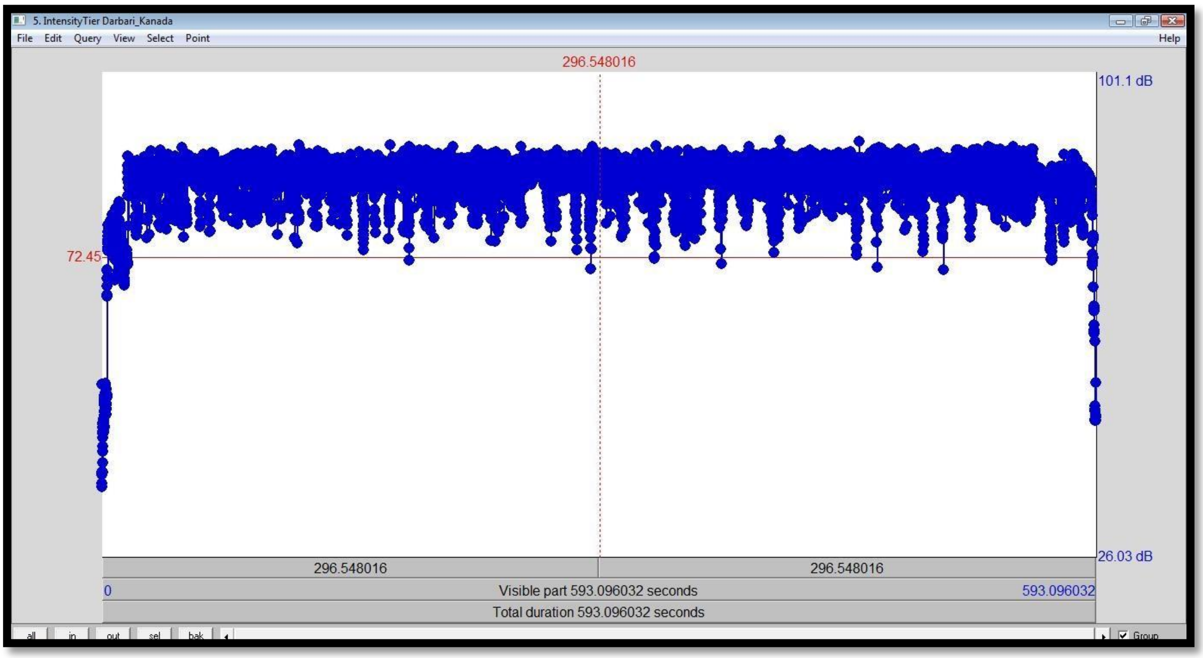
Frequency sampling:

Number of frequency bands (bins): 116

Frequency step (bin width): 43.06640625 Hz

First frequency band around (bin centre at): 0 Hz

5. Intensity



Object type: IntensityTier (Peaks)

Object name: Darbari_Kanada

Domain:

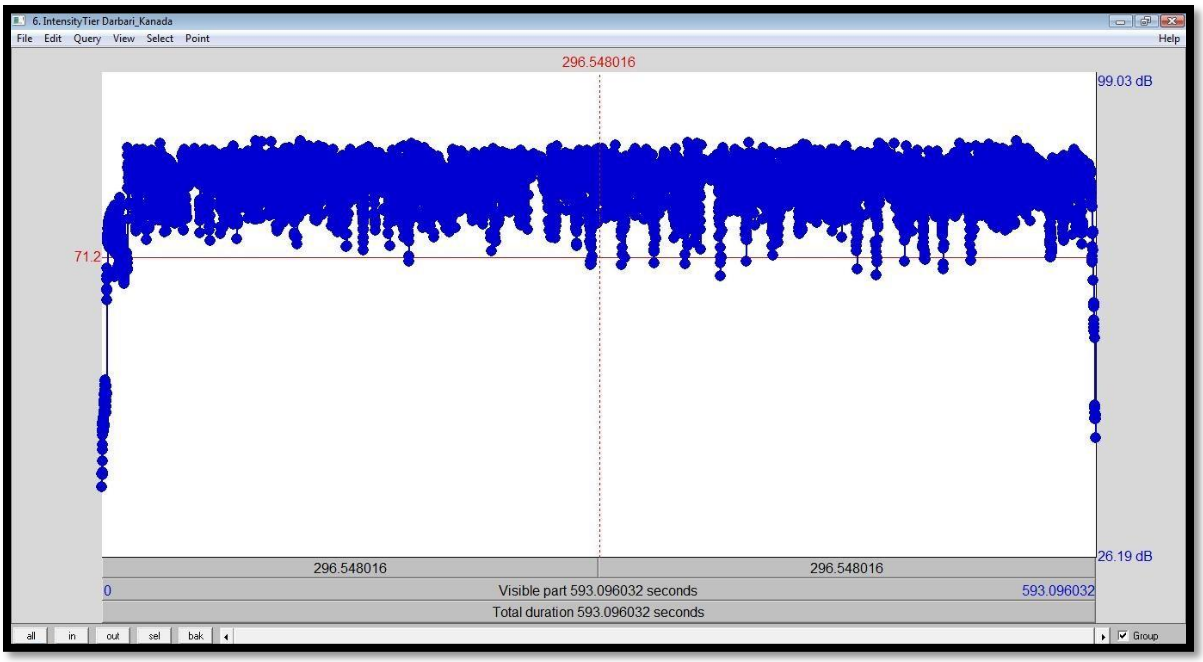
xmin: 0

xmax: 593.0960317460317

Number of points: 11133

Minimum value: 36.756223243959894

Maximum value: 90.41000255199869



Object type: IntensityTier (Valleys)

Object name: Darbari_Kanada

Domain:

xmin: 0

xmax: 593.0960317460317

Number of points: 11132

Minimum value: 36.599350073844995

Maximum value: 88.62199714432413

Object type: TextGrid (Silence)

Object name: Darbari_Kanada

Number of interval tiers: 1

Number of point tiers: 0

Number of intervals: 3

Number of points: 0

6. Manipulation

Object type: Manipulation

Object name: Darbari_Kanada

Domain:

xmin: 0

xmax: 593.0960317460317

Editor type: ManipulationEditor

Editor name: 8. Manipulation Darbari_Kanada

Data type: Manipulation

Data name: Darbari_Kanada

Editor start: 0 seconds

Editor end: 593.0960317460317 seconds

Window start: 0 seconds

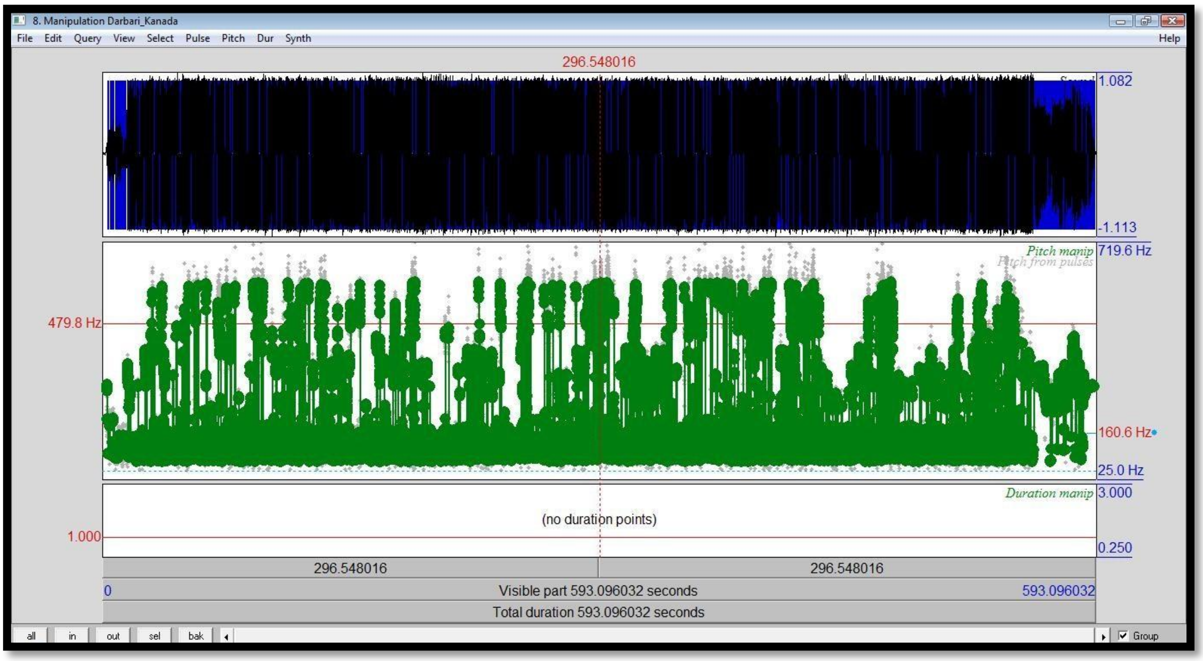
Window end: 593.0960317460317 seconds

Selection start: 296.54801587301586 seconds

Selection end: 296.54801587301586 seconds

Arrow scroll step: 0.05 seconds

Group: yes



7. Pitch Tier

Object type: PitchTier

Object name: Darbari_Kanada

Time domain:

Start time: 0 seconds

End time: 593.0960317460317 seconds

Total duration: 593.0960317460317 seconds

Number of points: 54000

Minimum pitch value: 74.94240799743959 Hz

Maximum pitch value: 599.687956583699 Hz

Editor type: PitchTierEditor

Editor name: 9. PitchTier Darbari_Kanada

Data type: PitchTier

Data name: Darbari_Kanada

Editor start: 0 seconds

Editor end: 593.0960317460317 seconds

Window start: 0 seconds

Window end: 593.0960317460317 seconds

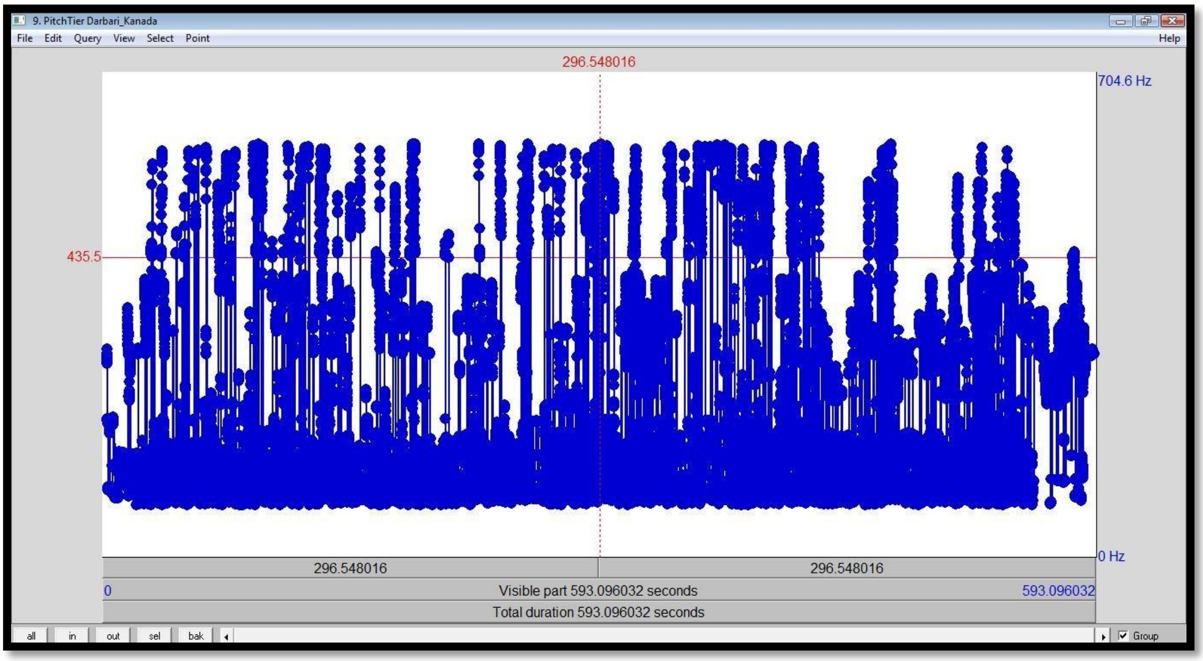
Selection start: 296.54801587301586 seconds

Selection end: 296.54801587301586 seconds

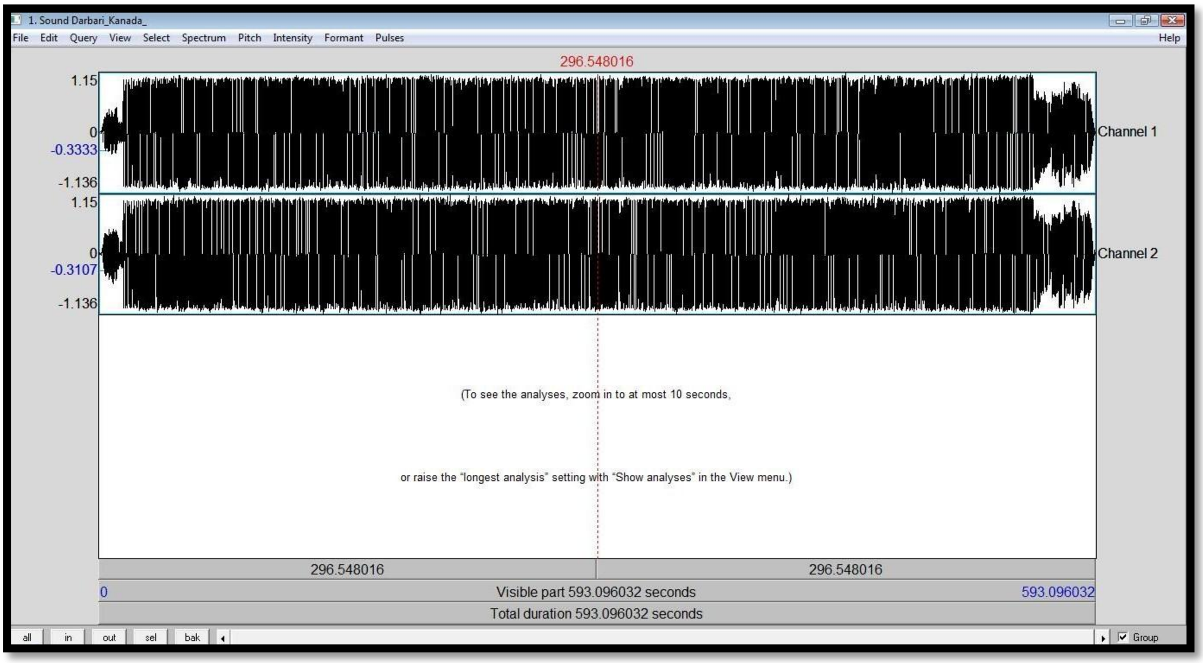
Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window



8. Visible Sound



Editor type: SoundEditor

Editor name: 1. Sound Darbari_Kanada_

Data type: Sound

Data name: Darbari_Kanada_

Editor start: 0 seconds

Editor end: 593.0960317460317 seconds

Window start: 0 seconds

Window end: 593.0960317460317 seconds

Selection start: 296.54801587301586 seconds

Selection end: 296.54801587301586 seconds

Arrow scroll step: 0.05 seconds

Group: yes

Sound scaling strategy: by window

Spectrogram show: yes

Spectrogram view from: 0 Hz

Spectrogram view to: 5000 Hz

Spectrogram window length: 0.005 seconds

Spectrogram dynamic range: 70 dB

Spectrogram number of time steps: 1000

Spectrogram number of frequency steps: 250

Spectrogram method: Fourier

Spectrogram window shape: Gaussian

Spectrogram autoscaling: yes

Spectrogram maximum: 100 dB/Hz

Spectrogram pre-emphasis: 6 dB/octave

Spectrogram dynamicCompression: 0

Spectrogram cursor frequency: 0 Hz

Pitch show: yes

Pitch floor: 75 Hz

Pitch ceiling: 500 Hz

Pitch unit: Hertz

Pitch drawing method: automatic

Pitch view from: 0 Hertz

Pitch view to: 0 Hertz

Pitch method: autocorrelation

Pitch very accurate: no

Pitch max. number of candidates: 15

Pitch silence threshold: 0.03 of global peak

Pitch voicing threshold: 0.45 (periodic power / total power)

Pitch octave cost: 0.01 per octave

Pitch octave jump cost: 0.35 per octave

Pitch voiced/unvoiced cost: 0.14

Intensity show: yes

Intensity view from: 50 dB

Intensity view to: 100 dB

Intensity averaging method: mean energy

Intensity subtract mean pressure: yes

Formant show: yes

Formant maximum formant: 5500 Hz

Formant number of poles: 10

Formant window length: 0.025 seconds

Formant dynamic range: 30 dB

Formant dot size: 1 mm

Formant method: Burg

Formant pre-emphasis from: 50 Hz

Pulses show: yes

Pulses maximum period factor: 1.3

Pulses maximum amplitude factor: 1.6

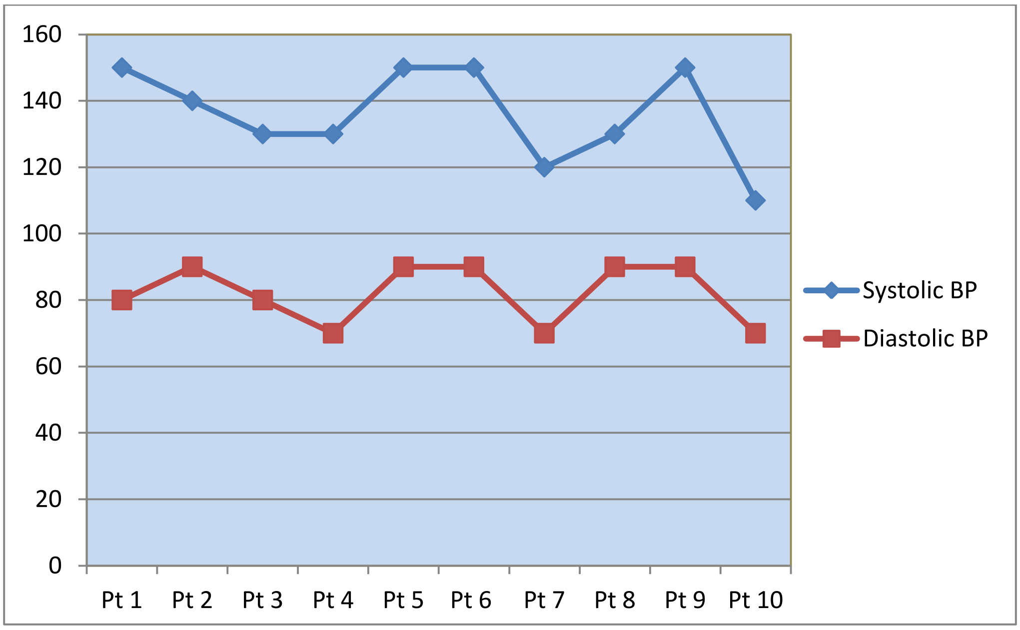
INTERPRETATION OF SOUND ANALYSIS

Table.1

Track	(Total Duration)	Sample Period	Sample Frequency	Mean	SD	Energy	Intensity	Periodicity SD (ERB)
Yadukula Kamboji	353.89	2.267	44100	-9.851	0.1884	12.564	79.48	2.811
Charukeshi	748.52	2.267	44100	-9.542	0.1845	25.5028	79.30	2.933
Kapi	521.88	2.267	44100	-0.0001	0.180	17.0685	79.12	2.706
Bilahari	548.68	2.267	44100	-0.0001	0.1883	19.4613	79.47	2.655
Kanaada	482.88	2.267	44100	-0.0001	0.2043	20.1581	80.18	2.0173
Senchurutti	451.22	2.267	44100	-0.5000	0.1734	13.5759	78.76	2.0304
Brindhavani	363.11	2.267	44100	-0.0171	0.3033	33.5175	83.63	2.0301
Mohana / Bhoop	424.08	2.267	44100	-0.0202	0.2918	36.4363	83.32	2.0328
Dharbari Kanaada	593.09	2.267	44100	0.0172	0.3262	63.3126	84.26	2.552

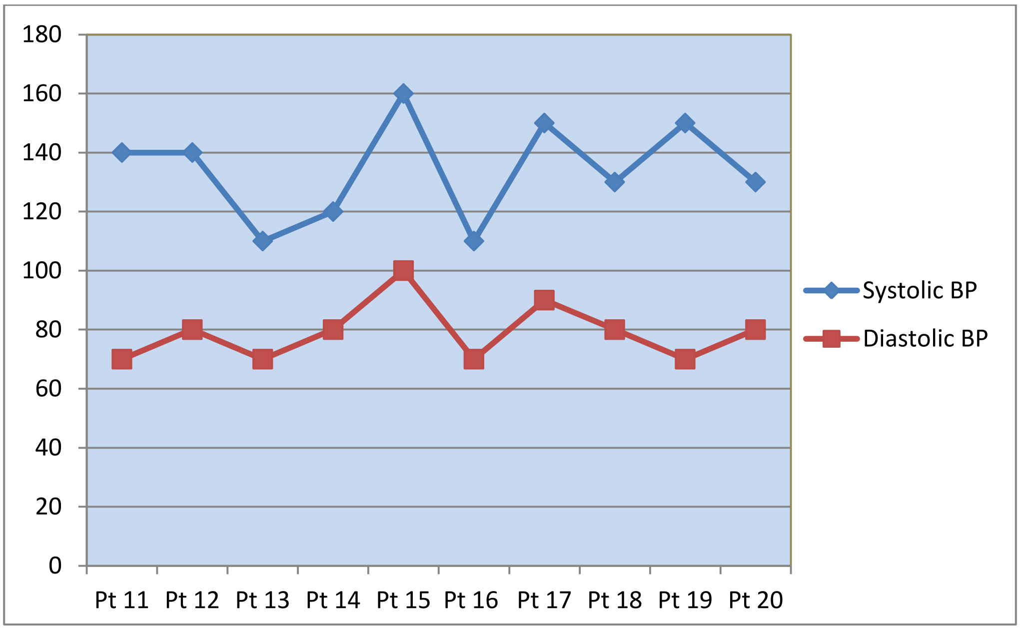
INTREPETATION OF CLINICAL TRIALS

Patients	Systolic BP	Diastolic BP
Pt 1	150	80
Pt 2	140	90
Pt 3	130	80
Pt 4	130	70
Pt 5	150	90
Pt 6	150	90
Pt 7	120	70
Pt 8	130	90
Pt 9	150	90
Pt 10	110	70



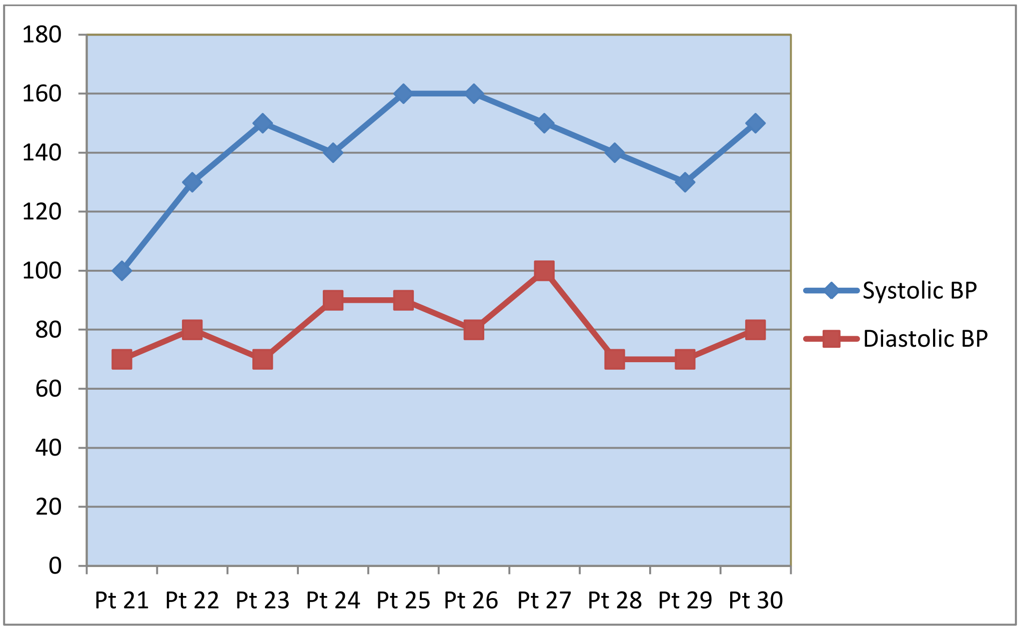
Blood Pressure in CKD Patients (Before Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 11	140	70
Pt 12	140	80
Pt 13	110	70
Pt 14	120	80
Pt 15	160	100
Pt 16	110	70
Pt 17	150	90
Pt 18	130	80
Pt 19	150	70
Pt 20	130	80



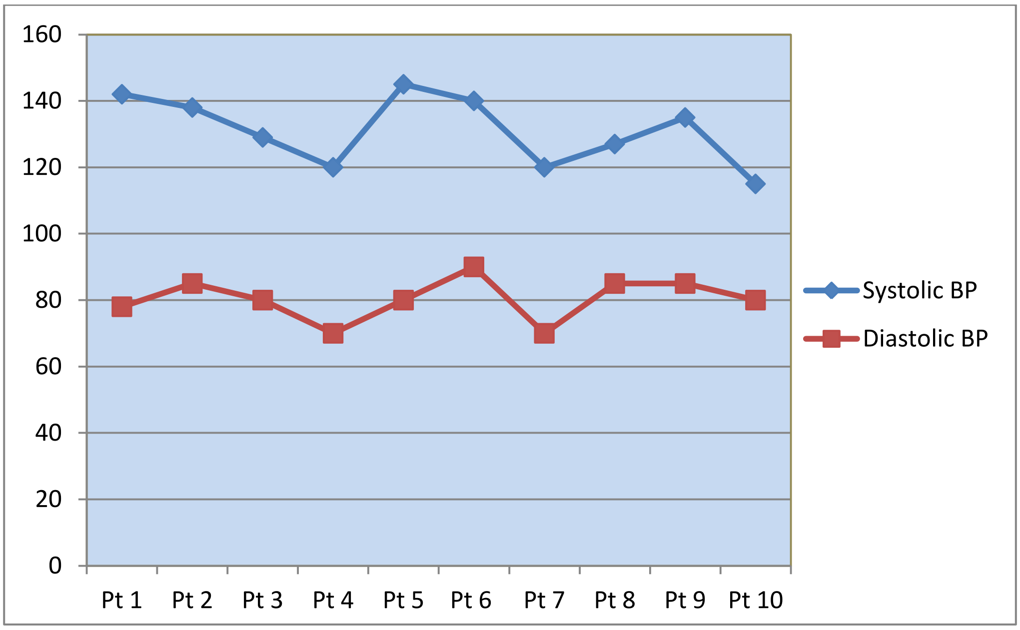
Blood Pressure in CKD Patients (Before Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 21	100	70
Pt 22	130	80
Pt 23	150	70
Pt 24	140	90
Pt 25	160	90
Pt 26	160	80
Pt 27	150	100
Pt 28	140	70
Pt 29	130	70
Pt 30	150	80



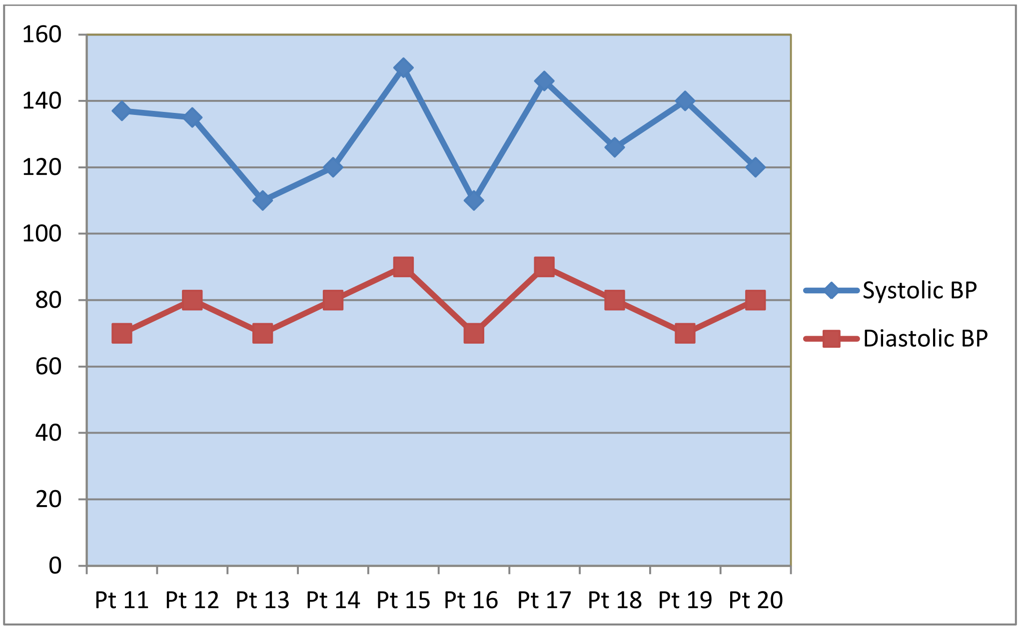
Blood Pressure in CKD Patients (Before Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 1	142	78
Pt 2	138	85
Pt 3	129	80
Pt 4	120	70
Pt 5	145	80
Pt 6	140	90
Pt 7	120	70
Pt 8	127	85
Pt 9	135	85
Pt 10	115	80



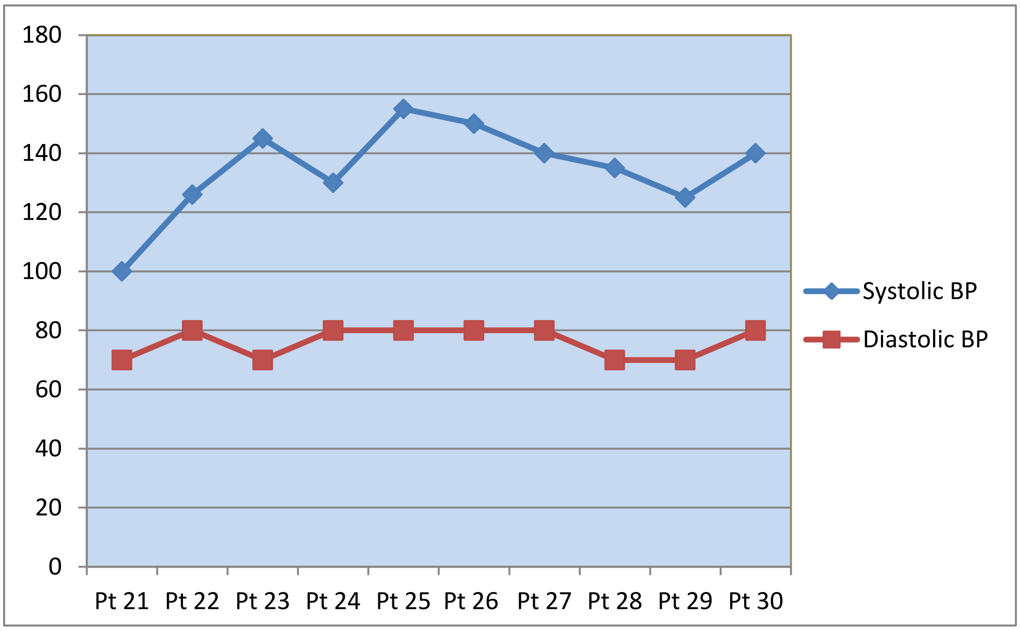
Blood Pressure in CKD Patients (15th day Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 11	137	70
Pt 12	135	80
Pt 13	110	70
Pt 14	120	80
Pt 15	150	90
Pt 16	110	70
Pt 17	146	90
Pt 18	126	80
Pt 19	140	70
Pt 20	120	80



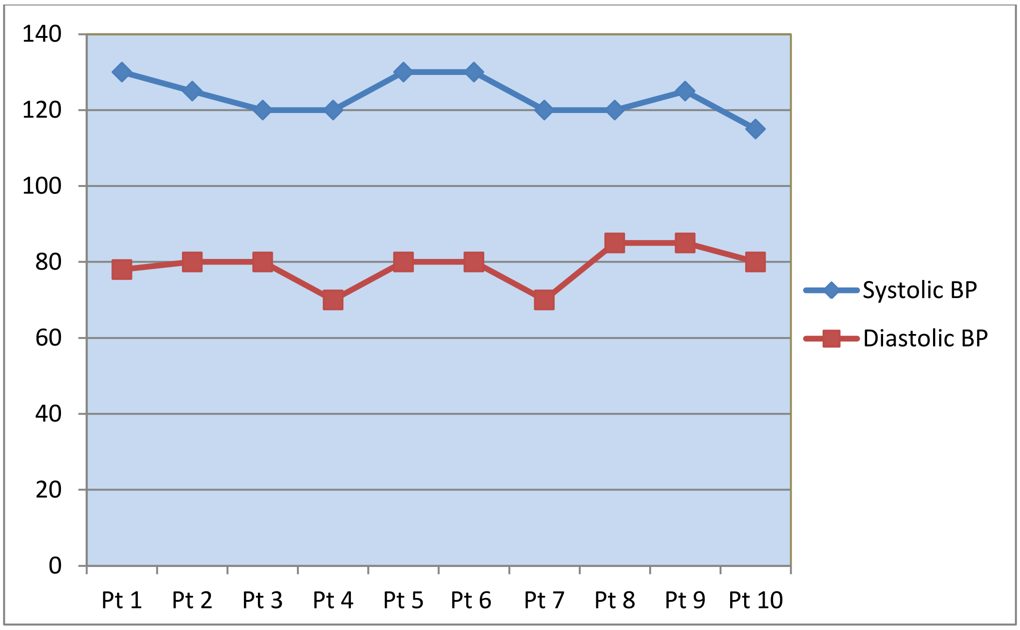
Blood Pressure in CKD Patients (15th day Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 21	100	70
Pt 22	126	80
Pt 23	145	70
Pt 24	130	80
Pt 25	155	80
Pt 26	150	80
Pt 27	140	80
Pt 28	135	70
Pt 29	125	70
Pt 30	140	80



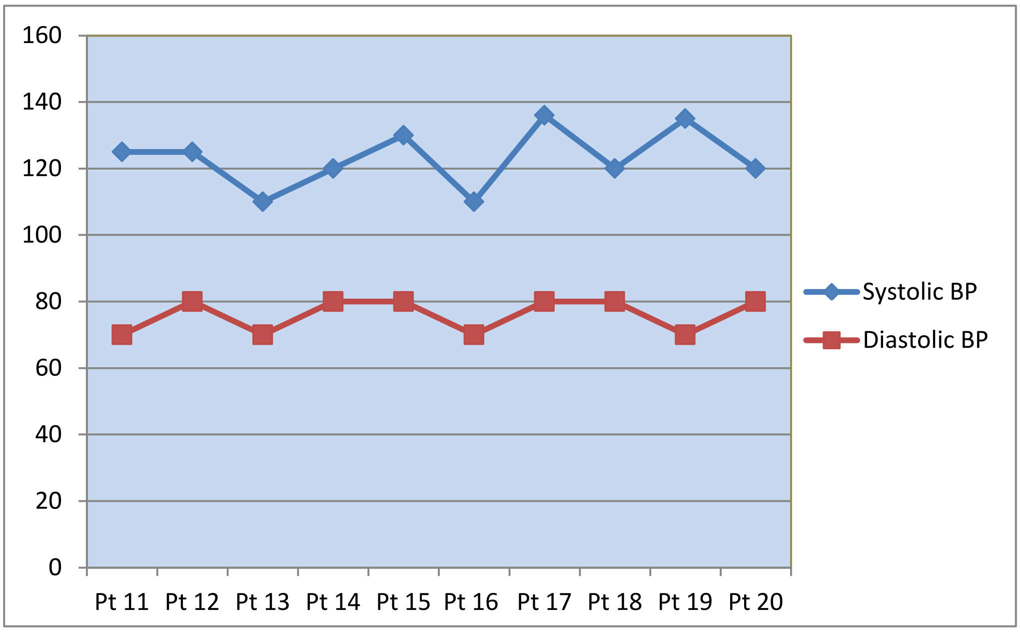
Blood Pressure in CKD Patients (15th day Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 1	130	78
Pt 2	125	80
Pt 3	120	80
Pt 4	120	70
Pt 5	130	80
Pt 6	130	80
Pt 7	120	70
Pt 8	120	85
Pt 9	125	85
Pt 10	115	80



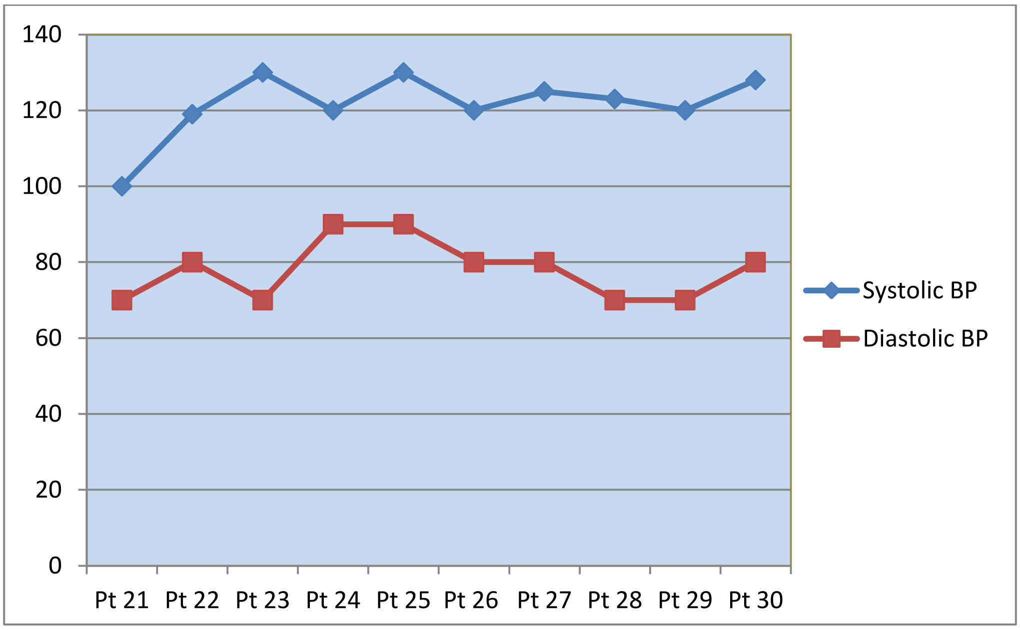
Blood Pressure in CKD Patients (30th day Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 11	125	70
Pt 12	125	80
Pt 13	110	70
Pt 14	120	80
Pt 15	130	80
Pt 16	110	70
Pt 17	136	80
Pt 18	120	80
Pt 19	135	70
Pt 20	120	80



Blood Pressure in CKD Patients (30th day Music Therapy)

Patients	Systolic BP	Diastolic BP
Pt 21	100	70
Pt 22	119	80
Pt 23	130	70
Pt 24	120	90
Pt 25	130	90
Pt 26	120	80
Pt 27	125	80
Pt 28	123	70
Pt 29	120	70
Pt 30	128	80



Blood Pressure in CKD Patients (30th day Music Therapy)

CLINICAL TRIAL INTERPRETATION ON RA PATIENTS

Patients	Reduction of Pain in joints
Pt 1	Yes
Pt 2	Yes
Pt 3	Yes
Pt 4	Yes
Pt 5	Yes
Pt 6	Yes
Pt 7	Yes
Pt 8	Yes
Pt 9	Yes
Pt 10	Yes
Pt 11	Yes
Pt 12	Yes
Pt 13	Yes
Pt 14	Yes
Pt 15	Yes
Pt 16	Yes
Pt 17	Yes
Pt 18	Yes
Pt 19	Yes
Pt 20	Yes
Pt 21	Yes
Pt 22	Yes
Pt 23	Yes
Pt 24	Yes
Pt 25	Yes
Pt 26	Yes
Pt 27	Yes
Pt 28	Yes
Pt 29	Yes
Pt 30	Yes

DISCUSSION

DISCUSSION

Suggestions that music improves rhythmic limb movements, gait, and freezing in patients with CKD are not new in the clinical literature, even though they are rather scarce. This study is the first to assess objectively the effect of a systematic program of active MT on standardized measures of CKD severity using a prospective, single-blinded design. Moreover, this randomized, controlled clinical study compared the efficacy of MT to highlight any eventual difference between the two methods in their effect on both physical and emotional functions. Our results demonstrate improvements in motor abilities and emotional status related to active MT. The improvement in performance was related mainly to changes in Hypertension. Although the MT-related motor response seemed to decline after each session, a trend of improvement was observed in the MT group in the overall evaluation.

Improvement in emotional functions was found both after each MT session and throughout the entire study period, but when measured for a month after completion of MT, the values returned to baseline levels. Significant improvements in BP and quality of life were also documented in patients undergoing MT. Meanwhile, led to a clear improvement in rigidity but did not induce any major changes in other variables.

Generally, MT serves as reinforcement of the hypertension program, but this kind of intervention is usually lacking in the motivational and emotional spheres, which could explain why traditional MT has little influence on mood state and why it is not easily incorporated into the patient’s lifestyle. It is well known, on the other hand, that psychosocial variables, such as emotional state or psychosocial stress, strongly influence abnormalities in gait and posture and other motor performances. In accordance with such observations, occupational and behavioral therapies based on psychological and motivational aspects can induce improvements in movement initiation and quality.

The beneficial effect on emotional variables measured in the MT group may be explained by the different emotional impact that MT has on patients, which is related to its high level of sensory stimulation and high degree of personal interaction. In line with this view, our study suggests a connection between emotions and the facilitation of movement.

SUMMARY

SUMMARY

The analysis of musical tracts revealed that all the 9 tracks were of same frequency of 44100 Hz and sample period of 2.267. Intensity analysis was slightly identical with range of 79.00 to 84.26. In accordance with the clinical literature, it may be argued that the MT-induced improvement in CKD & RA could be due to the effect of external rhythmic cues, which, acting as a timekeeper, may stabilize the internal rhythm formation process in patients with CKD. Indeed, it has been demonstrated that the initiation and execution times in sequential button pressing tasks are positively influenced by acoustic cues, as are gait velocity, cadence, and stride length. Along with the rhythmic aspect of music, another factor possibly involved in motor improvement is the affective arousal effect of music, which could influence both motivational and emotional processing. We hypothesize that the variable improvement in CKD & RA may be due to activation of the emotional neural-based network that involves the dopaminergic mesolimbic projections to the ventral striatum-intraccumbens nuclei, the circuit that is assumed to regulate motivational-incentive reinforcements of general behavior. Following this view, the motor facilitation in response to MT could be based on emotional reactions momentarily activating the cortical-basal ganglia motor loop, the circuit primarily affected in CKD. The behavioral evidence of a functional interface between the limbic and motor systems and the anatomical-functional sensorimotor integration of basal ganglia and cortical frontal regions further support this suggestion.

Listening to music seems to involve distinct neural processes that correspond to the basic components of music, such as rhythm, pitch, and timbre, or even to lexicosemantic access to melodic representations, functions that involve one or both hemispheres. Music has been shown to relax and reduce anxiety, modifying release of stress hormones, cardiac function, and respiratory pattern, these changes induced by music could be at the origin of positive findings in emotional and social items: A clear improvement in the PDQL scale score demonstrates the efficacy of MT on CKD patients' quality of life.

FUTURE WORK

FUTURE WORK

The Clinical Trials study of Classical Indian Music has given the outstanding recovery in CKD and RA patients. I would like to continue this project with a new strategy as my Post Doctoral Thesis.

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REFERENCES

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CERTIFICATES

CERTIFICATES

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

(A Deemed to be University declared under UGC, Govt. of India), KOLAR – 563 103

SDUAHER

KNOWLEDGE FOR POSTERITY

5TH NATIONAL RESEARCH SEMINAR

on

"Personalized Medicine - The Emerging Paradigm"

25th-26th April 2014

Certificate

This is to certify that ~~Dr.~~ Mrs. NETRAVATHI. N. of IHMA, Bangalore participated as a Delegate / Guest Speaker / Chairperson / member of Committee in the 5th National Research Seminar on "Personalized Medicine – The Emerging Paradigm" organized by Sri Devaraj Urs University, Kolar on 25th & 26th April 2014.

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