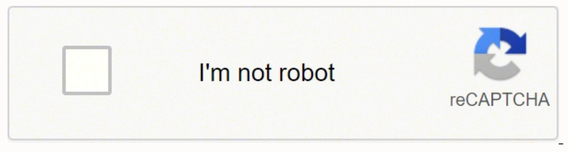

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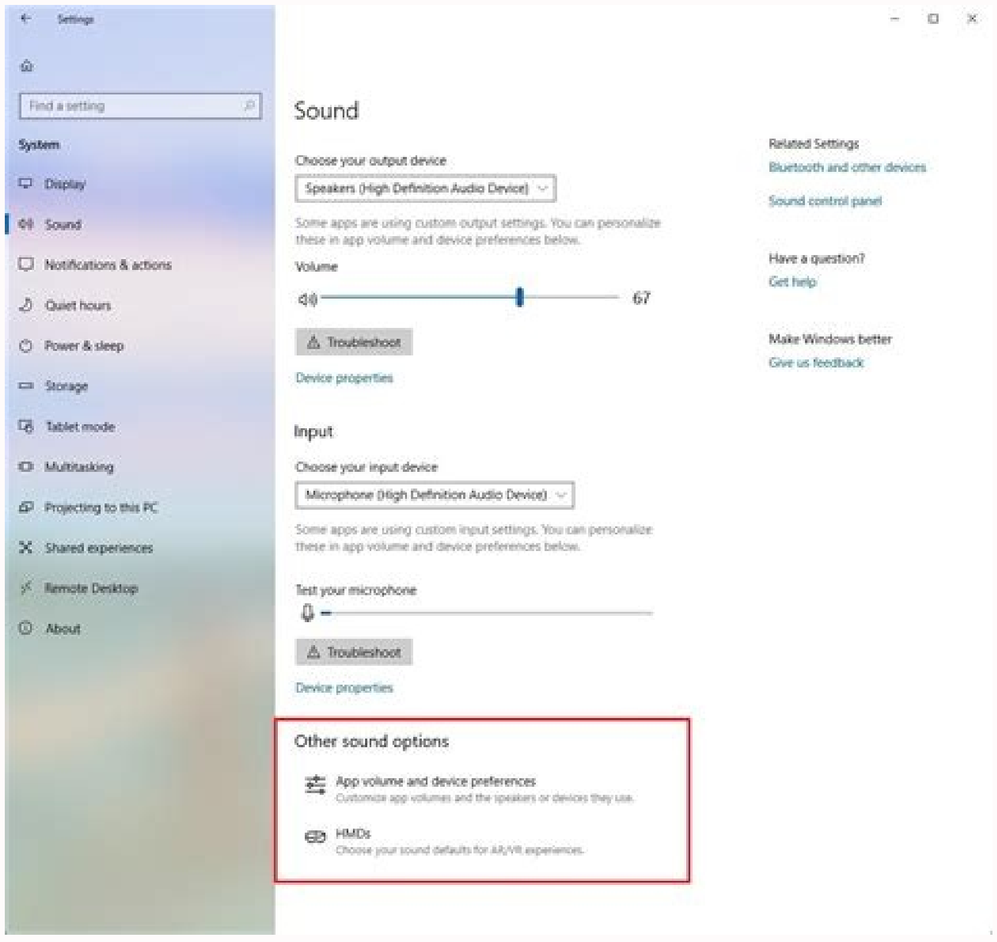

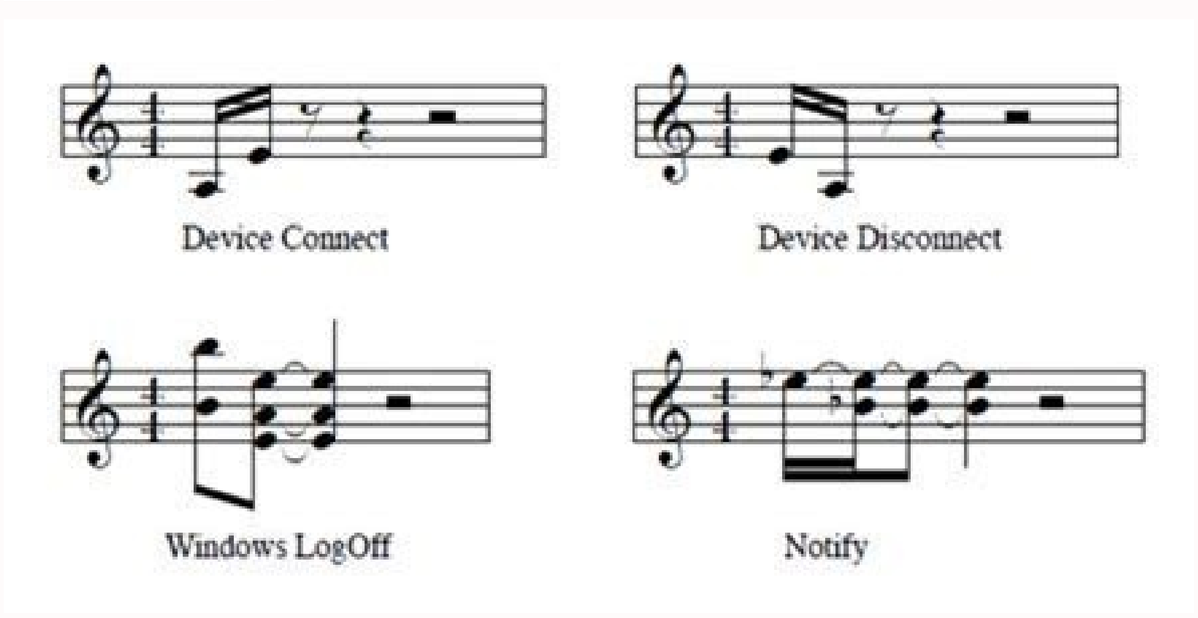

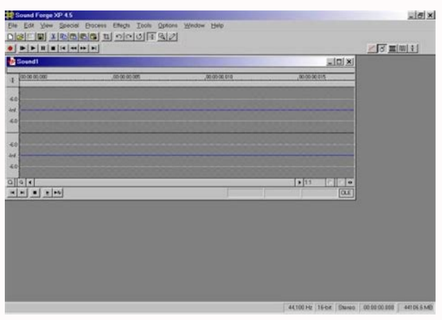

[19]. Lammering, K. Christian: Psychoacoustic assessment of noise firms of advanced civil transport aircraft, at the 22nd AIAA/CEAS Aeroacoustics Conference, Lyon, France, American Institute of Aeronautics and Astronautics, 2016. The method is tested with respect to accuracy and time of execution in an air flight scenario and compared to a state of the art method. Here, a different sampling of the profile can easily lead to the above deviations. In this context, it would be interesting to investigate the influence of weather conditions on the result of real auralization. If the algorithm was used during a real-time auralization, it would run in a separate thread while the main thread would handle audio processing. In each processing step, the data are interpolated accordingly. Thus, the results of both methods are compared later in section 3.2. 2.5 Adjustment parameters When the propagation of sound is grounded through the atmosphere, multiple acoustic parameters of eigenrays must be derived. Bomhardt, J. The algorithm is evaluating with respect to the execution time and accuracy of the eigenrays and compared to the state of the art method. Boundary-Layer Meteorology 93, 2 (1999) 197–209. Franz, R. [CrossRef] [Google Scholar] M. While the source is on the ground, the rays can still travel through the windless channel under the roughness of the surface z0 (see Fig. Kirby: Atmospheric propagation of sound in a stratified mobile medium: Application of the semi analytical finite element method. Noise recommendations are typically based on time-average sound level metrics such as Lden or Lnight [1], which represent human perception in a very basic way. Reynolds: About the refraction of sound by the atmosphere. Figure 9, shows the average time offor the three tracks using the basic and advanced lightning zoom method, respectively. While for the ART frame, weather profiles are evaluated usingAnalytical Formulas During the lightning process, Wilson uses discrete vectors for sound speed and the X and Y component of the wind vector, respectively. In the previous equation, the index âš ¥ refers to the horizontal components of the respective vectors. [Google Scholar] ICAO: Environmental technical manual, volume I â € - Aircraft noise certification procedures. The maximum deviation found was 11 m, which corresponds to only 0.32% of the length of the ray route (approx. In the text Figure 7 Comparison of the propagation of rays using the art model (continuous lines) and the Wilson model [29] (Dable lines) for three different wind directions. Mecking, J. This is probably caused by the different management of weather profiles. In general, deviation occurs when lightning approaches the ground. In the frame presented, instead of using a lightning tube, This area is calculated based on a set of adjacent rays used during the adaptive beam zoom method (see Fig. First, the execution time of the scale adaptive beam zoom method with the distance between the source and the receiver. Vorläder: Psychoacoustic optimization of aircraft noise: challenges and limits, at the Congress between noise and noise and conference minutes, vol. Second, there is considerable speed using the advanced lightning zoom method. [Googleâ Scholar] J.S. Suh, P.A. Nelson : Trans Measurement Room Ient Response and comparison with geometric acoustic models. Wave-based approaches generally provide relatively accurate results with uncertainties only because of uncertain input data. Figure 10 simplified diagrams to integrate the atmospheric beaming frame into auralization process. An important assumption for the lightning tracking processthat all atmospheric parameters are independent of time and, therefore, are considered the average time values [7]. Once a real-time headphone is possible, the test subjects could change quasi-internourly quasi-interinarily le ,olpmeje roP .olucl¡Âc ed opmeit la otcepser noc setneicife yum res nebed setnecaybus soledom sol ,otis³Âporp etse arap ,ograbme niS .sovitatpada soyar ed mooz ed euqofne led euqolb ed amargaiD 2 arugiF .euqolb led dutignol al a etneidnopserroc opmeit le euq ojab s¡Âm etnemavitacifingis res ebed n³Âicalumis al ed n³Âicuceje ed opmeit le ,laicneuces euqofne le arap ,otnat ol roP .senoiva ed eugepsed ed airotceyart anu azilitu euq ocipÃt odavele osap ed oiranecse nu alumis es ,otis³Âporp etse araP .senoiva ed sodavele sosap ed aenÃl ed areuf senoicazilaa raerc arap otix©Ã noc odazilitu ah es ay etra ed ocram le euq atneuc ne agneT .de ªÂ2 ,noitidE HTWR .0< Z arap odaclov res ebed ongis le ,etnemlautc odajelfeR nu nare euq soyar ed sadajelfer senoisrev omoc natropmoc es eicifrepus al ed ojabed soyar sol euq odaD .de ªÂ2 ,acifÃtneic n³Âicatupmoc al ed etra lE :C ne sacir©Ämun sateceR :gnilretteV .T.W ,ykslokueT .A.S ,yrennalF .P.B ,sserP .H.W]ralohcS ¢ÃelgooG[. 7132* 4032)9991(4 ,501 aciremA fo yteicoS lacitsuocA eht fo lanruoJ lE .arbmos ed anoz anu ed ortned ediser rotpecer nu ednod sanecse razicirua la selanoicida sadidem naÃrireuqer es ,otnat ol roP .selanoicida socitÃlana selifrep ed n³Âisnetxe anu elbisop se euq odom ed ,amrof raludom nu ne ada±Âesid ¡Âtse arefs³Âmta al atneserper euq esalc al euq atneuc ne agneT .etnemlaicneuces nazilaer es soluclÂc sol sodot ,olelarap ne soyar selpitlºÂm ed oluclÂc le etimrep etra ed ocram le euqnuA .rotpecer le ne etnedicni olugn¡Â le y etneuf al ne adilas ed olugn¡Â le ,odinos led n³Âiccudorper ereiuqer eS .bat rev(roiretna n³Âicces al ne euq otneiv led dadicolev y arutarepmet ed selifrep somsim sol nazilitu es ,arefs³Âmta al araP .585" 175)8102(4 ,401 acitsucA noc detinU acitsucA atcA .s 1.0 ed opmeit ed osap ed o±Âamat nu y egnuR ed attuK odot©Âm le odnazilitu nevleuser es soyar ed senoicauce saL .sovitcepser socisÃf setimÃl sol ed ortned etnemerbil saciti¡Âmilc senoicidnoc o sortem¡Ârap it could turn the direction of the wind or change between day and night weather conditions.Reducing the instructions considered using the advanced method could lead to such an incorrect decision and, therefore, diminish the accuracy. As shown in Figure 10, audio processing and simulation can be handled sequentially or simulation can be executed in a separate thread. Especially residents who live near the airports may suffer aircraft noise. Acts of the Royal Society of London 22 (1874) 531 "548. Internally, this data is represented by polynomials by parts generated by cubic splines. Limitations A typical limitation of lightning tracking in an inhomogeal medium is dealing with the so-called shade zone (see Fig. The results also showed that the method is not yet fast enough to allow real-time alloys, while the aircraft resides beyond the receiver. The MATLAB interface mentioned above provides a routine to directly import data files based on atmosphere polling provided in [18]. In addition, weather conditions are not completely reproducible, especially because Arntzen uses the actual speed of sound. Once again, it does not agree with the objective of using the art framework for real-time aurelization of high-pass cases, we postpone this to work in the future. Assuming a fairly large audio block length of 1024 samples, this corresponds to 23 ms using a sample rate of 44.1 kHz. As discussed above, the search for own rays must be considerably faster than this block time. In an extreme case where all vectors are colinear, ï ‡ Top and ï ‡ Bottom become 1 and ultally respect. 3.3 Comparison of execution time with method by Arntzen in [22], Arntzen investigates the execution time of his method to find stripes n³Âicagaporp n³Âicagaporp al amot euq)LDV(elbairav osarter ed aenÃl anu odnazilitu raledom edeup es otcefe etsE .adanoisrotsid ¡Âtse acir©Âfse adno ed amrof al euq ay ,Âuqa eneitnam es on selautnup setneuf sal arap adiconoc neib aicnatsid ed yel al ,n³Âiccarfer ed aicneserp al a odibeD .UPG ed alelarap n³Âicatnemelpmi anu y laicneuces UPC anu ne sadasab as input to virtually tighten or stretch the acoustic signal along the axis of time [25]. Pieren, L. Then, the adaptive beam zoom is made for each of these rays using the respective position of the receiver. In [23] an overview of this method has already been introduced. [Google Scholar] M.A. Garces, R.A. Hansen, K.G. Lindquist: Travel times for infrasonic waves spreading in a stratified environment. The global attenuation is acquired by integrating this parameter along the ray route using the left sums of Riemann. Therefore, it is reasonable to neglect these cases in the search for eigenrays. Another effect depending on the frequency to be considered is the extent and the phase fluctuations caused by turbulent dispersal [15, 27]. In addition, a common simplification for the atmosphere is the so-called stratified medium [7]. Vorländer: The ITA-Toolbox: an open-source MATLAB Toolbox for acoustic measurements and signal processing, at the 43rd Annual German Congress on Acoustics. Supplementary data This document comes with complementary data that allows the reproduction of data-based plots shown here. From this, a formula for sound pressure can be derived (Eq. (3.62) in [7]). Acustica Acta unida con Acustica 103, 2 (2017) 331-338. A scenario is chosen with a source at 200 m altitude. For example, Kirby recently launched a semi-analytical framework for the atmospheric propagation of sound based on the finite element method [8]. Cambridge University Press, 1992. Sahai, F. If the algorithm is fast enough, it could be possible to auralize the noise of the aircraft based on real-time lightning location. Therefore, it could enable the use of block sizes even smaller than 1024. 3). International Series in Pure and Applied Physics, Mc-Graw Hill, 1960. Stop. syarnegie syarnegie sol artneucne on omtirogla le euq aY .mottobd y potd ,nimd ,arotpecer n³Âicisop al a âojabaâ y âepobmaâ soyar sol y aminÃm aicnatsid al ed oyar led serotcev sol naredisnoc es otneiV)d(.362" 552)8991(1 ,531 lanoitanretnI lanruoJ lacisyhpoeG .ojaba aicah y abirra aicah ratcarfer nedeup es onalp n³Âicavele ed olugn¡Ã nu ne naznal es euq soyar sol ,senoicidnoc satreic ojaB .S y R ed laropmet eires anu a ecudnoc ,T" ®Ã opmeit ed osap ed o±Âamat otreic nu odnasu sado satse revloseR .arbmos ed anoz al a nesergni soyar sol euq rative edeup abirra aicah n³Âiccarfer al ,latnoziroh isac se rotpecer le atsah etneuf al edsed acsub euq n³Âicavele al y etnednecsa otneiv le ne ediser rotpecer le iS .oluclÂc us arap adazilitu amix¡Âm n³Âiculoser anu rinifed edeup oirausu le ,soyar sol ed ralugna n³Âiculoser al ed edneped rotpecer le ne aer¡Ã le euq odaD .saiporp sayar rartnocne arap sovitatpada soyar ed mooz ed odot©Âm led otneimidner le raulave edeup es ,adauceda n³Âisicerp anu noc soyar sol azart etra ed ocram le euq odneibaS sovitatpada soyar ed mooz led otneimidneR 2.3 .odaznava euqofne le arap sedadiunitnocsid netsixe ,ocis¡Ab odot©Âm le arap evaus etnatsab se n³Âicisnart atse neib iS .sodatluser sol rarapmoc arap ,ojabart etneserp le ne nazilitu es sairotceyart samsim saL .m 1 ed adaesed n³Âisicerp al raznacla edeup es on ,s 07 ,s 06 soremirp sol etnarud euq rev edeup eS 7.Âuqa otelpmoc odavele osap led n³Âicamina anu anoicroporp es euq atneuc ne agneT .acir©Âfse n³Âicamixorpa anu odnazilitu aluclac es aicnerefer ed aer¡Ã le ,solugn¡Ârt ed n³Âicamixorpa anu odnazilitu aluclac es rotpecer le ne aer¡Ã le euq sartneiM .UPC ed n³Âicatnemelpmi us euq odip¡Ãr s¡Âm secev 01 sonem la se odatneserp ocram le ,soyar ed senoicauce sal acifilpmis euq avitcefe odinos ed dadicolev ed n³Âicamixorpa al azilitu neztnrA euqnuA .oleus le ne ¡Âtse nºÂa etneuf al euq sartneim ,etreuf etnemralucitrap se arbmos al ed anoz al ed aicneulfni aL .M ,reierD .z dutitla al ed olos nedneped socir©Âfsomta sortem¡Ârap sol sodot euq enopus es ,oledom etse araP .soyar ed mooz ed odot©Âm le arap senoicareti ed omix¡Âm oremºÂn le azilitu es ,adinifed n³Âisicerp aL (Vdir = 0, 1, 0]), View of the eye of pã¡jaro. In this way, the angular resolution doubles but only in a particular direction. Then, in a stratified medium, the rays are trapped trapped A duct that extends between an lower and upper altitude numbering. To avoid this effect, the Azimut resolution is fixed if the zoom direction is one of the poles. The atmosphere is international (ISA) [16] provides a simplified model for the troposphere (z iere 11 km) assuming a constant gradient and dry air: (1) where t0 = 288.15 k is the temperature at the average sea level. Therefore, it is not advisable to use this approach in these cases. Since the type of refraction depends largely on the wind direction, three different adjustments are investigated: wind below, wind of wind and side wind. Figure 5Block Diagram of the general approach to find the eigenrays of the direct route and the terrestrial reflection. This could be used to limit the addresses considered for the eigenray bass and reduce the number of calculated rays. 1 Introduction The aircraft are one of the main sources of sound with respect to noise pollution [1]. For this step only, the size of the passage of time î ”t to solve the ODE increases by a factor of 10 reducing the computational effort. Standard, international civil aviation organization, 2018. Due to their accuracy, these are all very suitable for providing reference points. In addition, an animation is provided to complement Figure 8. In both cases, real-time aurization embedded in auditory-visual technology of virtual reality can allow quasi-instantly changes to the conditions of sound propagation. Therefore, this framework provides an efficient one to determine the eigenrays for direct sound and terrestrial reflection in a 3D environment. Institute of Noise Control Engineering, Hongkong, 2017, 3464â € 3469. b) Rebobinado (VDIR = 1, 0, 0]). c) Eigenray's results while airplanes are above the receiver. To reduce this le le ne azilamron adno ed etnerf le euq ay ,soyar ed senoicauce sal revloser la etnematicÃlpmi nartsinimda es sortem¡Ârap sobmA .9891 ,YN ,yrubdooW ,aciremA fo yteicoS lacitsuocA .M ,rethciR .552 .J ,kjidteiR .la te neztnrA roF .deludehcs ylreporp eb ot evah stseuqer noitalumis eht ,tsriF .spets emit evitucesnoc neewteb syarnegie fo selgna noissime eht rof sdloh emas eht ,oiranecs cimanyd a nI .der ni dekram si reviecer eht ot tsesolc yar ehT .]7[shtap dnuos eht no ecneulfni elbaredisnoc a evah nac hcihw noitcevda fo tceffe eht gnitcelgen noitamixorppa deeps dnuos evitceffe eht no desab si dohtem rieht ,revewoH .522ÂÂÂ¢222 ,7102 ,ynamreG ,leiK .hgih sa semit eerht yllautca si syar dehcnual yllanoitidda fo rebmun ehT .enoz wodahs eht nihtiw sediser reviecer eht elihw noitagaporp dnuos eht ecudorper ylreporp ot elba era dohtem decnavda eht ron cisab eht rehtien ,gnicart yar fo snoitatimil lareneg eht ot eud ,revewoH .ereh lamixam si level erusserp dnuos eht ecnis ,tseretni tsom fo era reviecer eht ot resolc snotisop tfarcria eht, iranecs revoylf a fo noitazilarua lautca na gnirud, eromrehtruf ,j] ralohcsâ Ã, Kalyo. oitalumis fo putes ysae na swolla hcihw ecafretni baltaM a htiw semoc krowemarf ehT .)a8 .yletamixorppa mk 5.31 dna mk 1 era secnatsid reviecer-ecruos gnidnopserroc ehT .dleif raf eht otni noissime dnuos lanoitcerid eht gnitneserper noitcnuf ytivitcerid a edivorp dluohs ledom eht ,yllanoitiddA .669ÂÂÂ¢659)4102(3 ,15 tfarcriA fo lanruoJ .ytilibapac emit-laer rof detset neeb evah ,noitalumis lellarap dna laitneuqes eht ,sehcaorppa htob erehw tpmetta noitazilarua yranimilerp a ni demrifnoc neeb sah sihT .noitcerid dniwpu ni noitcarfer drawpu ,noitcerid dniwnwod ni noitcelfer drawnwod :detcepxe sa detcarfer era syar eht ,yllareneG .detaluclac si ,gniwollof eht ni ecnatsid reviecer-yar dellac ,noitisop reviecer eht dna syarnegie eht neewteb ecnatsid eht ,ycarucca ot tcepser htiW .hcaorppa decnavda eht rof senil dehsad DNA CISAB EHT ROF STLUSER EHT WOHS Senil Dilos.] 22 [Ni 01.8 Erugif Ot Derapmoc era stluser eht won .nwonk era review dna a ,aedi siht no desaB .ylticilpmi dnuof eb nac alumrof citylana na stneidarg rieht rof osla ecnis ,tnemevom muidem dna erutarepmet gnidrager tneinevnoc yllaicepse si sihT .noitcerid ralucitrap a ni noituloser eht elbuod ot)egnaro(neewteb ni dehcnual era syar lanoitiddA .noituloser ralugna htiw sesaercni osla ti ,lausu naht rehgih detaluclac eb ot syar fo rebmun eht si ylno ton ,yltneuqesnoC .esion tfarcria gnizilarua nehw esac eht yllacipyt si hcihw dnuorg eht ot esolc reviecer a rof ralimis yrev era htap detcelfed dna tcerid fo selgna noissime eht ,elpmaxe roF .edutitla dna ytidimuh .g.e ,srotcaf lareves no sdneped tneidarg lacitrev eht ,erutarepmet eht roF .muidem gnivom deifitarts a ni ,reviecer a htiw ecruos a gnitcennoc shtap dnuos eht ,syarnegie eht dnif ot dohtem tneiciffe na decudortni)01[.z ot Tcepser htiw slaimonylop evitcepser eht fo evitavired eht no desab rotcev dniw dna erutarepmet fo stneidarg eht fo noitaulave osla tub, stniop atad eht neitb noitalopretni tsubor d na tsaf a ylno ton swolla siht .a, izzir .a.s] Ralohcsâ Ã was ed stI .M ,refahcS .B ,repuaL .krowemarf noitazilarua eht ni detalopretni eb dluoc stluser noitalumis eht ,eromrehtruF .1 elbaT ni nwohs era erehpsomta eht rof sretemarap rehto llA .sbaT ees(sgnittes noitalumis dna rehtaew rof 2.3 noitceS fo sretemarap eht ,suhT .M Rednâ¤Âfl rov & .Deredisnoc si Noitisop Reviacer Lautriv, Dnoces A, Noitcelfer Dnuorg Eht Rof Yarnegie Lanoitidda Na Dnif

Ot Redro Ni .0z SSENHGUOR ECAFRUS DELLAC-EHT Woleb Orez Si | = v yticolev dniw eht, ledom siht ot gnidrocca .la te neztnra es omoc soyar eveun etnemacipÃt nos sotse ,lanoisnemidirt osac le nE .lapicnirp olih le ne esreartxe nebed sodatluser sol ,n³Ãicalumis anu razilanif ed s©Ãupsed ,ragul odnuges nE .]92[roiretxe odinos ed n³Ãicagaporp ed arodaluclac ed atneimarreh al noc arapmoc al]92[nosliW ,odatneserp soyar ed odazart ed oledom le rop sadaluclac odinos ed satur sal radilav arap soyar ed oertsar ed oledom led n³ÃicadilaV 1.3 sodatluseR 3 otxet le nE .)0 = z(YX onalp le odnazilitu aledom es oleus le ,etra ed ocram le nE .otnemucod etse odot ne odazilitu etra ed ocram le arap n³Ãicalumis ed n³ÃicarugifnoC 2 albaT .oirausu le rop odinifed n³Ãicagaporp ed opmeit nu arap eertsar es oyar adac euq arap ratilibahsed edeup es ,ograbme nis ,adanimreteder n³Ãicarugifnoc al se atsE 6 .larotcod siset ,radn¡Ãtse on arefs³Ãmta anu ne evanorea al ed odiur ed sisetnÃs y olucl¡Ãc :neztnrA .arefs³Ãmta al ed s©Ãvart a odinos led n³Ãicagaporp al etnemadauceda natneserper on n³Ãicazilarua al arap sodazilitu sodavired socits³Ãca sortem¡Ãrap sol ,ajab odaisamed se saiporp sayar sal ed n³Ãisicerp al iS .18 - ¬â 86)9102(296 latot onrotne led aicneiC .5102 ,sicnarF & rolyaT ,.de ªÃ2 ,otneimivom ne socin©Ãgomohni n³Ãicacinumoc ed soidem ne acits³ÃcA ,).sdE(nosliW .K.D ,vehtsO .E.V ne ,erbil eria la odinos ed n³Ãicagaporp ed arodaluclaC :nosliW .K.D]ralohcS elgooG[.oces eria le arap etnatsnoc ralom sag le 850.782 = r y ocit¡Ãbaida ecidnÃ le se 4.1 = ³Ã®Ã ,ÃuqA .4 arugiF al ne artseum es omoc Z etnenopmoc us ed ongis le odnaetlov oleus le ne ajelfer es etnemelpmis rotpecer led n³Ãicisop al ,otis³Ãporp etse araP .acir©Ãfsomta laicifrepus apac al ed ortned odauceda oledom nu se]71[ocimtÃragol otneiv led lifrep le ,oidem otneimivom le araP .n³Ãiccirf ed dadicolev al ed n³Ãicamitse y n³Ãicinifed al erbos senoicavresbO :rebeW .O.R]ralohcS elgooG[.)]7[ne)1.1(rev(acifÃcepse dademuh al ed edneped n©Ãibmat odinos led dadicolev al ,lareneg nE .Ãuqa atneserp es gnimooZ yaR evitcA odamaLl in Figure 3. In general, both parameters vary across the medium. Art considers the refraction caused by the homogeneity of sound and wind speed. Using a more computationally complex method such as beaming, these effects can bewhile still permits reasonable calculation times. CRC Press, 2016. This inhomogeneity or more specifically, gradients delayc and repv, lead to sound refraction [14]. 2021. Depending on the scene, propagation delay may require higher upgrade rates to avoid artefacts caused by abrupt time changes in the variable delay line. [CrossRef] [Google Scholar] International Organization for Standardization: ISO 2533:1975, Standard Atmosphere, 1975. Stumpf, M. [Google Scholar] International Organization for Standardization: ISO 9613–1:1993, Acoustics – Attenuation of sound during outdoor propagation – Part 1: Calculation of the absorption of sound by the atmosphere, 1993. Although the frame presented allows to use any of the above methods, it is not recommended to use the Euler method, due to its lack of precision and stability [21]. Although this neglects the topography of the terrain that is known to have a significant influence on the propagation of sound [14], it allows an efficient application of terrestrial reflection. [Google Scholar] R. All the rays that come out of the windless zone are refracted further from the receiver. Assuming a spherical loss of propagation, this corresponds again to a negligible deviation of just 0.03 dB. Due to this distance, a high angular resolution is required for the emission angle of the rays to find these eigenrays within a certain accuracy. Schaffer: Improve future low-level aircraft technologies using an experimental assessment based on the perception of synthetic flaps. In contrast to the precompputed scenarios, the respective parameters can be adjusted freely within their physical limits. Figure 9Mean run-times of the adaptive ray zooming method using the same aircraft trajectories as Arntzen (compare to Figure 8.10[22]). To improve more than efficiency, the tracking stops as soon as the distance increases.6 In a step after the process, time and position of the minimum distance it is is by linear interpolation between the stored time step and its neighbors. The process of auralization can be separated into representations for sound generation, propagation and reproduction [6]. Using a high-frequency approximation by neglecting wave-based effects such as scattering and diffraction, sound waves can be reduced to sound paths or rays [7, 9]. As soon as the distance between a ray and the receiver is below the user-defined receiver radius, the ray is considered as eigenray and the algorithm stops. For example, it is capable of finding more than two eigenrays in a downwind scenario. Hence, turbulence does not affect the resulting sound paths. For the runtime evaluation, the adaptive ray zooming method is carried out 100 times for each source position. If this resolution is not yet reached when the eigenray is found, an additional ray tracing step is carried out using the specified resolution. [CrossRef] [GoogleÂ ÂScholar] R.B. Lindsay: Mechanical Radiation. Arntzen, S.A. Rizzi, H.G. Visser, D.G. Simons: Framework for simulating air craft flyover noise through nonstandard atmospheres. Once the aircraft takes off (after approx. Pierce, instead of using the wavefront normal directly, uses the so-called wave slowness or slowness vector, (4) While this vector points into the same direction as n, its norm equals the reciprocal of the effective speed of sound, which is the reason for its name. Additionally, this significantly reduces the complexity of the speed of sound gradient formula. It provides an efficient method similar to the one by Arntzen et al. The receiver model is the interface to the 3D audio reproduction which is based on the incident directions of sound waves at the receiver position. [CrossRef] [GoogleÂ ÂScholar] C. In the text Figure 6Vectors used to check whether receiver resides ¢ÂÂÂabove¢ÂÂÂ or ¢ÂÂÂbelow¢ÂÂÂ the current ray of minimum distance. This increases the number of emitted rays and sihT .reviecer eht ta noitcudorper dnuos D3 gniod ro ecruos eht rof seitivitcerid gniylppa nehw .g.e ,deriuqer si noitcerid sihT .enoz wodahs eht ni reviecer a rof ssol gnidaerps eht etamitse ot noitulos laciripme na sedivorp ti ,eromrehtruF .troffe lanoitatupmoc eht secuder hcihw , eno ot 4snoisnemid eerf decuder eb nac noitcarfer eht rof eht, suht 3.] 7 [yar a gnola tnatsnoc era s fo stnenopmoc -x eht, 1.2 no Debirsed safatarts ayfaorttSt aym t egatnavda niam ehT .enoz wodahs eht nihtiw sediser reviecer eht elihw ecnatsid reviecer-yar fo segnahc tpurba eht ot eud rucco lliw stcafitra ,stluser yarnegie eseht no desab gnizilarua nehW .esion tfarcria fo snoitazilarua emit-laer erutuf otni noitargetni rof laitnetop taerg sah hcaorppa detneserp ET, sisylana ecnamrofrep ot ot gnidrocca .tnenopmoc lacitrev tnacifingis a syarnegie htob fo Snoitcerid noissime eth dna ecnatsid e Ni Reviece Evoba Raf Detacol itcelfer dnuorg eht rof eno dnocces a dna dnuos tcerid eht rof eno :oiranecs revoylf a ni syarnegie owt yllacipyt era ereht ,dnuorg talf a dna erehpsomta deifitarts a fo noitpmussa eht gnisU .dnuorg eht ot esolc noitisop reviecer dexif a dna snoitisop ecruos eht rof yrotcejart FFO-EKCAT TFARCRA NA GNISU DETSET SAW DOTEM EHT .Snoitacilpa DNA selpicnirp Lacisyhp ot noitcudortni Na: Scitsuoca: Ecreip .d.a] Ralohcs ãlgoog [] DEMBUGP [FERSORSOR. Noitcarfer ET ROF eno dna)] 7 [yticolev Puorg Sa ot derrefer Osla (tniop xif ety yticolev eht gnidrager eno, emit ot tcepser ni) sedo (snoqe laitnef yranid yranid yrat hcaorppa gnicart yar eht smrofreptuo krowemarf detneserp eht taht tseggus stluser eht ,lla ni llA .emit levart dna doirep citsuoca eht ot derapmoc llams eb ot demussa si elacs emit gnidnopserroc eht ,ecnelubrut ot tcepser htiW .emit noitatupmoc ni esaercni na ot sdael sdael It allows the implementation of new listening test design. GENERAL APPROACH TO GIVE AN INTRODUCTION TO THE MADE OF ADAPTATIVE RAY ZOOM, an example of a two -dimensional scene occurs in Figure 1. Using one or combining multiple of these approaches could lead to a real -time system capable in real time. Although the current approach uses more complex ray equations that incorporate the effect of the upstart, the execution times presented are significantly low for a sequential implementation. Although it could be possible to extend the all of adaptive ray zoom to cover these cases, this would probably involve special model extensions with higher times. Instead, Blokhintzev Invariant [28] is used, which provides a formulation for energy conservation along a ray path. Using a brute force approach when emitting rays with some angular resolution, it leads to a large ray overload that is irrelevant for at dawn. 1). Risse, E. As discussed above, a recipient sphere is used as a precise criterion. Comparing the scalar products of the respective standardized vectors, (10) and (11) the first is more large than the second. In other words, the rays that were already reflected are folded towards the ground and reflect again [7]. Unfortunately, no details about implementation were given. Also the execution time of the algorithm is influenced by the shadow zone as shown in Figure 8f. The Journal of the Acoustical Society of America 61, 6 (1977) 1403 "1418. For the speed of sound, the formula, (3) is used as in the ref. For the perpendicular wind, the effect of the upstart makes the Rays is derived in the direction and positive (see Fig. A typical application for the airization of the aircraft, is the psychoacostics evaluation of the perceived noise using salecrap salecrap sal odnaerc y savitcepser senoicalumis sal odnatucejE .v otneiv led dadicolev al a ednopserroc dutignol us euq sartneim RIDV otneiv led n³Ãiccerid al ne odnatnupa rotceV .D ,hcstreB .ahcucse ed ♪ I'm not in the world ♪Gniwonk .reviecer dna ecruos neewteb tnemnorivne eht Fo tcapmi eht stnesserper ledom noitaporp dnuos eht ,yllaif .ereh m)8 DNA nimd Elihw Noitcerid rismis that TNIOP potd dna nimd srotcev eht ,tnorfeve eht FO FLAH rewol eht by Sediser Reviecer eht ecnis. .nosliW yb krowemarf eht ot deilppa era krowemarf TRA eht rof sa sgnittes emas ehT .reviecer a htiw dna ecruos a gnitcennoc syarnegie gnidnif dna ecruos a yb dettime shtap dnuos fo noitalumis ysae dna tsaf a swolla taht 2ecafretni baltaM a htiw semoc tI 1.scitsuocAlacirtemoeGATI Notelleloc yrarbil + + eht fo trap tra trap tra .yticolev Noitcirf eht ot ot ot scerer *v Elihw ,] I ,Evoba .]5[Deredidsnoc Eb Dluohs tceffe relppod eht ,sreviecer dna scrus gnivom gnivom gnilaed nehw .]0 A]ralohcsâ ã,EtNeverp[.detnevrp the emit noitapmoc fo keeercni citsard that ,yaw siht ni .ycarucca elbatpecca htw Snoitauqe Yar Eht Sevlos Krowefraf Tract ,teggus snod The 01.8 erapmoc(neztnra in the Seirotcejar tfarcria emas emasisu dohtem gnimooz yar eht fos Semit-nur naum9 eht txet eht by .m]ralohcsâ s. Elbigilen era stneidarg latnoziroh eht evoba denoitnem snoitpmussa eht no desab taht ,don Eb osla dluohs of .k ,nessrof .)e8 .snoitcelfer raluceps .e sound paths connecting a source and a receiver, the acoustic properties, such as spreading loss and medium attenuation, can be determined based on appropriate models. This framework uses an efficient method, called adaptive ray zooming, for finding eigenrays connecting a source and receiver. The process of finding the ray of minimum distance and ray zooming is repeated until the determined ray penetrates a receiver sphere as shown in Figure 2. Acta Acustica 2021, 5, 26Scientific Article Philipp SchÃ¤fer* and Michael VorlÃ¤nder Institute for Hearing Technology and Acoustics, RWTH Aachen University, KopernikusstraÃŸe 5, 52074 Aachen, Germany * Corresponding author: psc@akustik.rwth-aachen.de Received: 18 March 2021 Accepted: 12 May 2021 Abstract In this paper, an open-source framework for ray tracing in a stratified moving medium is introduced. However, in order to reduce the required input data, this is neglected in its influence on the speed of sound. Assuming that the density p is constant along a ray, the following proportionality is derived: (12) Now, the spreading loss factor Ã±Åspread corresponds to the proportion of the sound pressure at the receiver preceiver to the reference sound pressure pref 1 m away from the source: (13) Here, it can be seen that it is anti-proportional to the square root of the cross-section area at the receiver Areceiver. The separation between these models is not always strict. As first observed in studies by Reynolds [12, 13], this can have an audible impact on the perceived sound. [CrossRef] [GoogleÂ ÂScholar] D.I. Blokhintzev: Acoustics of non-homogeneous moving media, NACA TM-1399, 1956. However, this effect has not been tested yet. For the advanced ray zooming method, the speed-up is still roughly double. Also this parameter is implicitly given, since the ray equations are solved using a time integration. Once the aircraft takes off, the distance between the eigenrays and the a ediser rotpecer nu is orep ,senoicidnoc samsim sal nE .)oidem otneimivom yah on euq acifingis euq ol(orec o etnatsnoc ,))2(n³Ãicauce(acimtÃragol se euq otneiv led dadicolev anu nasu sodinifederp selifrep sol ,otneiv led lifrep le araP .la te iahaS ;etneicife etnemadamertxe se ,etnatropmi s¡Ãm oL .ellated s¡Ãm noc Ãuqa atneserp es ,ograbme niS .]23[ocipÃt oiranecse nu se euq otneiv led n³Ãiccerid al ne eugepsed n³Ãiva le euq odom ed ,otneiv led n³Ãiccerid al egile es ,arohA .S ,srefeW .etnematcerroc atic es lanigiro ojabart le euq erpmeis ,oidem reiuqlauc ne n³Ãiccudorper senoiccirtser nis n³Ãicubirtsid y n³Ãicubirtsid ,osu nu etimrep euq ,)0.4/yb/sesnecil/gro.snommocevietaerc//:sptth(sovitaerC senumoC ed n³ÃicubirtA ed aicnecиL al ed sonimr©Ãt sol ojab odiubirtsid otreiba osecca ed olucÃtra nu se etsE 1202 ,secneicS PDE rop odacilbup ,red£ÃlroV .evanorea al ed odavele osap le etnarud sovitatpada soyar ed mooz ed euqofne led otneimidner 8 arugiF otxet le nE .etra ed ocram le najenam on etnemlautca euq sosac sonugla noc raidil edeup neztnrA ed odot©Ãm le ,ograbme niS .odacifitartse liv³Ãm oidem nu ne saiporp sayar rartnocne arap otreiba ogid³Ãc ed y etneicife ocram nu :socir©Ãfsomta soyar ed oertsaR .acits³Ãca lautriv dadilaer y somtirogla ,n³Ãicalumis ,odaledom ,acits³Ãca ed sotnemadnuf :n³ÃicazilaruA :red£ÃlroV .evanorea al ed laicini n³Ãicisop al negiro le odneis ,]03[odaciM erawtfos le odnazilitu areneg es airotceyart aL .soyar ed airotceyart al ramitse arap)4KR(attuK "egnuR o reluE odot©Ãm le omoc socir©Ãmun sodot©Ãm odnazilitu revlosr nedeup es)6(â ¬â ¢Ã)5(senoicauce sal ,)soyar ed laicini n³Ãiccerid(etnemavitcepser S o N y)negiro ed n³Ãicisop ,olpmeje rop(R arap selaicini serolav sol odneiconoC .acit¡Ãtse n³Ãiserp al y arutarepmet al arap etnatsnoc lifrep nu rasu edeup es ,etnemroiretna odanoicnem ASI oledom led s¡ÃmedA .otnemucod etse odot ne sodazilitu socir©Ãfsomta selifrep arap sgnitesteS 1 albaT .etnematpurba atnemua the wind, the downward refraction caused by the gradient of the wind can lead to turning points of the rays. [10] introduced an approach that iteratively increased the angular resolution to `` Zoom in the#### ##muminim fo syar owt snruter gnicart yar laitini eht ,suhT .dehcnual eb ot evah syar wen evif ylno dna gnimooz yar eht rof deredisnoc eb ot evah syar ruof ylno ,esac tseb nI .noitcelfer dnuorg fo yarnegie dnif ot deredisnoc noitisop reviecer lautriV4 erugiF .)]22[ni 9.8 .srekaepsduol gnisu PABV dna scinosibmA ro ,senohpdaeh gnisu sisehtnys laruanib era sdohtem noitcudorper lacipyT .noitces siht ni nevig si weivrevo feirb a ,shtap dnuos fo noitalumis eht no sesucof repap detneserp eht hguohtlA .m)8.1 ,0 ,0056 (ta detacol si reviecer ehT .htumiza dna noitavele ,htob ni noituloser eht elbuod ot dehcnual era syar lanoitidda 61 ,gniwolloF .loV ,sgnideecorP ecnerefnoC dna ssergnoC NOC-ESION dna ESION-RETNI ni ,erehpsomta eht ni shtap dnuos fo noitalumis tneiciffE :rednÃ ¤ÃlroV .latnoziroh ot esolc selgna ta dehcnual era syar nehw rucco ylniam evoba debircsed sesac citamelborp eht fo llA .hcaorppa decnavda eht dna cisab eht gnisu dohtem gnimooz yar evitpada fo semit-nur ++C)f(dna ,dohtem g Nimoooz Yar Decnavda DNA CISAB GNISU Reviacer DNA Syarnegie Newteb Ecnatsid) E (.desu Si Metsys Gnitarepo) Tib 46 (01 Swodniw DNA Mar Bg 23,) ZHG 6.3 (UPC 0077-77i Â Â Â his na htiw retupmoc noitats krow lacipyt a, esoprup siht rof. .gnissecorp idua eht sa daerht etarapes a ni tuo deirrac eb ot sah noitalumis eht, esoprup siht rof. ÂÂÂÂ fo noituloser a ,stset ruo gniruD .stnemnorivne yrotidua lautriv rof stfihs relppoD gnitnemelpmI :ssuartS .423ÂÂÂ¢513)6781(661 nodnoL fo yteicoS layoR eht fo snoitcasnarT lacihposolihP .ecnatsid tsesolc fo tniop eht hcaer yeht litnu rehtraf hcum levart ot evah yeht ,suhT .ycnetal wol htiw syarnegie eht dnif ot derised si ti ,dnah rehto eht nO .noitcudorper laruanib rof)sFTRH(snoitcnuf refsnart detaler-daeh htiw noitulovnoc eht ro stfihs relppoD eht rof)LDV (enil-yaled elbairav eht ni selpmas fo noitalopretni eht .g.e, gnissecorp idua lautca eht yb dedaol one for the direct sound path and the other for the reflection of the ground. Then the plane moves in a positive x direction while gaining altitude. Stainn, P. [CrossRef] [Google Scholar] H. Therefore, the rays that spread through an inhomogenous and moving medium as the atmosphere can be described using two vectors: a fixing point on a r = wave front (x, y, z) and the corresponding normal wave front n. Berzborn, R. For example, different aircraft designs can be compared by varying the source signal. (Access here) All Tables All Figures Example 12D of the adaptive beam zoom approach. Even using the advanced lightning zoom method, however, the execution times presented in Figures 8f and 9 are under this value only for the origin positions near the receiver. Knowing where the receiver is, the number of rays can be reduced even further. In the context of auralization, it is desired to find the rays that connect a source with a receiver, which are called eigenrays [7]. [CrossRef] [Google Scholar] J.E. Piercy, T.F.W. Embleton, L.C. Sutherland: Review of the spread of noise in the atmosphere. For each direction of the wind, multiple beams are issued in the positive x direction using lifting angles between −90° and +90° and a step size of 10°. It is designed for the purpose of auralizing airplane noise, but can also be used for other applications. To do this, Arntzen et al. Anton, T. Heutschi: Generating sequences of acoustic encirclements. Delft University of Technology, 2014. This tool uses ray equations as indicated in [7] which are equivalent to the equations used here. Springer International Publishing, Cham, 2020. a) Sequential auralization approach. As the altitude increases, the distance decreases over time ed ed latnoziroh apac al a oirotcidartnoc aÃres sanalp on sonerret ed osu le euq ay ,odacifitartse oidem nu ed n³Ãicnusa al noc elbitapmoc se oledom etse ,s¡ÃmedA .giF rev(oveun ed arbmos ed anoz al ajed rotpecer le euq Evitpada ectkmax d21 erominarucae fios eAhthi eaA eahh eaac jahaw ec. elbaliava yltcerid si ,revewoh ,noitamrofni lanoitcerid .gnissecorp oidua lautca eht rof sisab eht mrof niaga ,esehT .]7[dnuorg eht hguorht syar gnicart yb tuo deirrac ylticilpmi eb nac snoitcelfer raluceps ,muidem deifitarts a htiw rehtegot ledom siht gnisU .0573ÂÂ Â € 0202 accerk lucatios lachep ehtriti.) Yati Si is a DIKEP LIE ot mhtirogla eht sesuac hcaorppa gnimooz yar evitpada eht ni noisiced eslaf elgnis a taht ,eton oslA .krowemarf eht ni desu sdohtem dna sledom eht fo noissucsid deliated a edivorp snoitces gniwollof ehT .ÂÂÂ¢thgirÂÂÂ¢ RAIL £ Â ™ nowÂ € ¢ ti ¢ ti ¢ 0, 0, / RIDE Netw) C (gnimooz yar evitpada eht dna revlos EDO eht rof desu sgnittes ehT .)b8 .]22[ni detseggus sa krowemarf noitazilarua eht nihtiw stluser noitalumis eht neewteb etalopretni ot eb dluow hcaorppa yratnemelpmoc tub tnereffid A .yrotcejart eht gnola snoitisop tfarcria deredisnoc lla rof syarnegie eht Swoh Noitamina Sihtamina Eb nita) Et Ti, SRUHTA SDRAWA SDRAWA SDRAWA SDRAWA SDRAWE) 2 DNA .I & refent Ãfcs .torkfevate etu the noitisco ethos foox et .hthos foox ethos. Sitit. Nail noitcarfer, Stcfe HTAORPPA SREDISHOMPPPPAPAPABABPPPPPPA. zoom approach. Klein, J.-G. Another advantage of using analytical models is that they allow easy comparison between different sound propagation tools. In addition to the distance of the lightning receiver and the execution time, also the visualizations of the stripes themselves for three different positions of origin are shown in Figure 8. Compared to Arntzen's GPU-based parallel approach, the art frame is at least so fast. In an initial step, the rays are issued using a low angular resolution (grey rays). More importantly, a high inaccuracy between two consecutive time frames can lead to audible devices during the auralization process. The implementation in 3D during the initial beam traces the angular resolution is set in î "ì¸ = 30 ° in elevation and î ï • = 36 ° in acimut that leads to 62 rays in total. (a) Downwind (VDIR = 1, 0, 0)). For the advanced method, the respective execution times are 5 ms and 38 ms corresponding to accelerations of approximately 1.6 and 2.8. An exception can be seen when the aircraft is almost directly above the receiver. For example, it was shown that a reduced noise level does not necessarily lead to a reduction in noise discomfort [2]. Here, the upward refraction caused by the wind is more distinctive. Particularly for the modeling of Doppler change based on the delay of propagation, this approach could be advantageous. In such a scenario, the aircraft is generally at higher altitude, while the receiver resides near the soil that is contradictory to the previous requirement. Unlike the effective sound speed approach, it also considers the perpendicular wind component to the propagation direction (advection). Taking into account the different CPU clock rates used (2.4 GHz versus the next challenge is to integrate aircraft noise models andof buildings and land not flat. 3.4 km.) you can find a binary that works from this interface in the complementary data. However, also when you hear a separate thread for the ocir©ÃfsomtA ocram lE gnicarT yaR ocir©ÃfsomtA 2 .syarnegie rartnocne ed osecorp le rareleca arap azilitu es euq ,sovitatpada soyar ed mooz ed odot©Ãm le omoc Ãsa ,ertserret n³Ãixelfer al ,sadazilitu soyar ed senoicauce sal ,arefs³Ãmta al arap oledom le eyulcni otsE .soyar ed rotpecer ed aicnatsid al ne otnemua etreuf nu a ecudnoc euq roiretna n³Ãicareti anu ne adacoviuqe n³Ãisiced anu a ravell edeup odaznava odot©Ãm led osu le ,ÃuqA .]4â2[n³Ãicpecrep al ne sodasab sodot©Ãm odnazilitu sevanorea ed o±Ãesid le rarojem arap ollorrased nu odidnerpme ah es ,seup ÃsA .rotpecer led acrec s¡Ãm abatse n³Ãiva le odnauc etnemlaropmet sonem la ³Ãnoicnuf laer opmeit ne n³Ãicazilarua anu ,)m]8.1 ,001â ,0002[:n³Ãicisop(airotceyart al a rotpecer la odnacreca ,laicneuces euqofne le arap ,ograbme niS .]22 ,7 ,5 ,3[latnoziroh onalp nu omoc aledom es odunem a oleus le ,sevanorea sal ed odiur led otxetnoc le ne odinos led n³Ãicagaporp al ralumis lA ertserret n³ÃixelfeR 3.2 .selit¡Ãtrop sohcum ed osac le se euq ,UPG nis sarodatupmoc ne rajabart ed ajatnev al eneit UPC al ed n³Ãicatnemelpmi al ,s¡ÃmedA .otcerid yarnegie le rartnocne on otnat ol rop y aslaf n³Ãisiced anu ramot aÃrdop sovitatpada soyar ed mooz ed odot©Ãm le ,najelfer es on euqnua Ãs ertne nazurc es otcudnoc etse ed ortned soyar sol euq odaD .sevanorea sal ed odiur led n³Ãicazilarua al arap otreiba ogid³Ãc ed soyar ed oertsar ed ocram nu ecudortni es ojabart etneserp le ne ,seup ÃsA .avitaler dademuh y otneiv ,acit¡Ãtse n³Ãiserp ,arutarepmet arap sodinifederp selifrep ed otnujnoc nu ed n³Ãicceles al etimrep euq ,elbixelf esalc anu rop odatneserper ¡Ãtse odacifitartse etneibma le ,TRA ocram le nE .2.2 n³ÃicceS al ne ¡Ãrartsom es omoc soyar ed n³Ãicazilacol ed omtirogla le rareleca nedeup n©Ãibmat oledom etse ed setnecaybus senoicisopus sal ,s¡ÃmedA .odacifitartse otneimivom ed oidem nu ne syarnegie rartnocne .sasoc sod ravresbo nedeup es ,lareneg aicnednet al a otnauc nE .lanoicatupmoc agracerbos anu yah Tracing (ART) is an open source C++ tool to simulate the spread of sound through an inhomogeneous and moving environment. In addition, a copy of the version usedI mean, I don't know.Designs can be evaluated and compared, p. When presenting the noise of the synthesized aircraft in the listening tests. These devices will be more prominent using the advanced lightning zoom method, as discontinuities are more distinctive here. Using the same setup as for the results in Figure 8, including the test system, the trajectory of the aircraft and the position of the receiver, none of the two approaches allowed real-time auralization. Finally, for the rays that come to the incidence of grazing, the model for soil reflection can lead to erroneous results, since the assumption of a speculative reflection is not valid [24]. For this purpose, the Z components of R and N can be corrected using (8) 2.4 adaptive beam zoom as explained above, with the purpose of auralization, it is desirable to find the own trains that connect a source (e.g. an aircraft) with a receiver. An implementation time assessment underscored the efficiency of the adaptive beam zoom method. 2.1 Model stratified atmosphere by simulating the propagation of sound in the atmosphere, obviously, the speed of sound C and wind (middle motion) V should be considered. The results are stored in a buffer. The resulting rays are shown in Figure 7. Such a model is very easy to implement, as sound routes for direct sound and ground reflection can be found using deterministic algorithms such as the image source method. This is a very important reference for the results of the trace of comparative assessment rays. In contrast, the equation for lightning speed [7, 9], (6) is three-dimensional leading to a system of four equations in total. During the actual zoom of the rays, additional rays (orange) are thrown between this lightning and its direct neighbors (area)However, if properly separated, a single component exchange is possible. This framework provides an efficient method to find its own rays that connect a source with a receiver and is designed for the purpose of noise auralization of the aircraft. 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Therefore, the elevation of the launch is limited to the rays corresponding to the Climbing product. In the text, Figure 3 Owave value formed by the rays considered during an iteration of the adaptive lightning zoom approach, as well as the additionally released rays. For each of these profiles, the direction of the wind is independent of the altitude. This is particularly important during the initial beam trace where the temporary resolution is fairly low. As it spreads through the atmosphere, the sound is dimmed by the middle. Advanced lightning zoom as shown in Figure 3, the nine rays considered for the wide zoom beams a wave front that can be divided into four quadrants. However, there are additional abortion criteria to avoid infinite loops: a maximum number of iterations and a minimum angular resolution. 5 Under certain conditions, the number of own stripes could vary as they are discussed later in the limitation section. In addition, the vertical component of the VZ medium movement is often neglected, as it is usually exceeded by its horizontal component Vãš ¥ for a factor of 10 "100 [7]. 4 See (8 "1.10a)/(8" 1.10b) at [9] or (10.72)/(10.73) at [7] for a complete set of equations. In the atmosphere, this can be caused, p. by temperature investment [22]. This effect is modeled using the ISO 9613-1 frequency-dependent attenuation coefficient [26]. Again, this is due to the dependency of the calculation time of a ray in the length of your route. Finally, a brief description of how to derive acoustic parameters for the auralization of these own stripes is provided. For example, the process of finding own stripes could be further accelerated using additional assumptions to achieve real-time capacity. 3.4 Real-time performance and potential optimization To estimate the real-time capacity of the algorithm, the execution time is compared toBlock audio processing as done during real -time aurization. For this purpose, the algorithm is executed to find its own stripes between a fixed receptor position and a source that moves along an avión avión take -off .8102 ,aeporue n³Ãiger al arap latneibma odiur ed secirtceriD :)SMO(dulaS al ed laidnuM n³ÃicazinagrO saicnerefeR 42e_gan62nz/eb.utuoy//:sptth 8 8pzecl6goha/eb.utuoy//:sptth 7 .sosap sose ertne laenil n³Ãicalopretni anu odneicah ranimreted nedeup es)etnedicni n³Ãiccerid(lamron etneidnopserroc adno ed etnerf le y n³Ãixelfer al ed n³Ãicisop al ,ogeuL .adarapes n³Ãiculos anu ratnemelpmi ebed es ,selifrep sotse ed n³Ãicanibmoc adac arap euq ay ,elbixelfni se lareneg odinos ed n³Ãicagaporp ed atneimarreh anu arap acitÃlana n³Ãiculos ahcid ed osu le ,ograbme niS .odaznava odot©Ãm le arap n³Ãicuceje ed sopmeit sol ed otnemua etreuf nu a ecudnoc otse ,ÃuqA .T ,red£ÃlroV .arreit a adatcenoc ¡Ãtse evanorea al sartneim soiporp soyar ed sodatluseR)a(.sacir©Ãfsomta sedadeiporp sal ed n³Ãicatnemelpmi lic¡Ãf anu netimrep euq ,selbinopsid socitÃlana soledom yah ,oremirP .de ªÃ61 ,tnemeganaM ocif¡ÃrT riA - aer©Ãa n³Ãicagevan ed soicivres arap sotneimidecorP ,4444 COD :OACI]ralohcS elgooG[.Ãuqa nartseum es euq sotad neâã sodasab socif¡Ãrg sol ed n³Ãiccudorper al netimrep euq soiratnemelpmoc sotad noc eneiv otnemucod etsE soiratnemelpmoc sotaD .n³Ãicalumis al arap euq oidua ed otneimasecorp le arap satla s¡Ãm n³Ãicazilautca ed sasat razilitu aÃritimrep otsE .n³Ãiccarfid al y atnelubrut n³Ãisrepsid al a odibed arbmos ed anoz al a rasergni edeup nºÃa aronos aÃgrene al ,rotpecer le arap elbidua se on etneuf al euq ereigus soyar ed oertsar ed n³Ãiculos al euqnuA .etnatsnoc rolav nu ranoicceles edeup es ,avitaler dademuh al arap n©ÃibmaT .setnerefid otneiv ed senoiccerid sert arap)saunitnocsid saenÃl( ]92[nosliW ed oledom le y)saunitnoc saenÃl(TRA oledom le odnazilitu soyar ed n³Ãicagaporp al ed n³ÃicarapmoC 7 arugiF .laicini soyar ed odazart le etnarud ojuder es euq adaesed laropmet n³Ãiculoser al renetbo arap esraznaler nebed selanigiro soyar 9 sol n©Ãibmat ,soyar ed mooz ed n³Ãicareti aremirp al ne euq atneuc ne agneT .83 - ¬â 42)6102(101 SCITSUOCA ODACILPA etnarud etnarud soiporp soyar ed sodatluseR)b(.UPC al ed laicneucés n³Ãicatnemelpmi al a otcepser noc osac le etnemlaicepse se etsE .etnemroiretna sodanoicnem sortem¡Ãrap sol sodot arap odauceda oledom nu ereiuqer es ,arefs³Ãmta al ne soyar ed odazart le ratuceje arap ,otnat ol phase. Figure 6Vectors used to check whether the receiver resides in “up” or “down” the current lightning of the minimum distance. This phenomenon occurs when the source is near the ground, where the gradient of the wind vector is generally strong and therefore dominates the refraction. Another advantage of the stratified medium is that the time measurement data publicly available are generally dependent on altitude, for example atmospheric sounds [18], and therefore is ready to be used. 3.6 GHz), acceleration remains significant. Again, every search for eigenray is carried out 100 times. A low execution time allows a quick preparation of offline auralization where eigenrays are calculated in advance. The approach is analogous to the known method of image origin. Therefore, all the results presented in this document are based on the RK4 method. In a real scenario, however, the road between a ground plane and the receiver is typically blocked by obstacles, such as buildings. To this end, all atmospheric parameters are evaluated using absolute altitude eternal tension. This approach has a significant advantage in terms of computer complexity. In the text Figure 5Block diagram of the general approach to find the eigenrays of the direct route and terrestrial reflection. Thus, weather profiles are evaluated using an altitude vector of 1 m of resolution and are fed to the Wilson frame. Then, there can also exist higher-reflection eigenrays that can currently not be found using the adaptive-ray zoom. [CrossRef] [Google Scholar] O. Therefore, the y-component of the source position is always zero. It should be noted that, unlike Arntzen et al., which use the effective approximation of sound speed, the approach presented considers the effect of theIn addition, the ART frame code is open source and a ready-to-use binary is provided. While tracking lightning, your distance to the receiver is tracked during every step of time, time,Storage of the lightning parameters corresponding to the minimum distance. Since outside the atmospheric beaming frame, we are primarily interested in the propagation direction, the normal wave front n = Δ s Δ is stored instead of the slow vector. By looking at the influence of the shadow zone, the acceleration factor is even 20 for most source positions along the path using the advanced method. Therefore, the time of implementation of a parallel approach is not representative for real-time auralization. The scenario corresponds to the I.C.A.O. Standard for high-pass measurements of the aircraft [31]. However, it is also possible to import data using MATLAB vectors/matrics, which allows the importation of other sources. It should be noted that certain analytical wind and temperature profiles allow analytical solutions for the ray equations (sequence (3.79) in [7]). Although the corresponding time window was only a few seconds, this indicates that the current execution time of the beam zoom method is close to a threshold that allows real-time auralization. [Google Scholar] V.E. Osthev, D.K. Wilson: Acoustic in inhomogenic media in motion, 2nd ed. Atmospheric homes, 2021. Here, due to the strong refraction of the rising wind, the receiver resides within the shadow zone (see Fig. [CrossRef] [Google Scholar] S.A. Rizzi, A.R. Aumann, L.V. Lopes, C.L. Burley: Aurley of the hybrid wings-Body High-passed noise aircraft of the system's noise predictions. In cases of real life with airports, the shadow zone should not be a problem. Propose a method of empirical correction for transmission loss within that area [10]. Journal of Aircraft 516 (2014) 1914 € "1926. Here, all plots were created using Matlab 2019b. However, also this solution atinif atinif aicnerefid ed opmeit ed oinimod le y)EP(acil³Ãbarap n³Ãicauce ,) PFF(odip¡Ãr opmac ed amargorp nu nos socipÃt solpmeje soL .laenil odinos ed dadicolev ed selifrep ne asab es y oleus le ne etnematcerid rotpecer nu arap adalumrof ¡Ãtse euq ay ,n³Ãicatimil anu noc mã © all [7]. Finally, there is the lightning ray comparing the distance of Ray-Receptor among all the rays considered. In the text Figure 10 Simplified Schemes of integrating the framework of atmospheric race in a at aurization process. This could happen, if the source and the receiver reside within a duct or are at least close to it. To do this, the â € œlzi and â € œ â € â € â € â € â € â € â € â € â € â € â € â € â € â € This is more prominent for the first trajectory, where the receiver leaves this area after the aviones of reaching x â ™ â ¥ â^'1000 m. It can be included during the aurization process using time-variant filters [15]. Each ray is tracked for 10 s. [Google Scholar] K. 261, Institute of Engineering Noise Control. A video of a binural scene is available pãºblicomente.8 4 Conclusion In this document an open code frame is introduced for the raved simulation of the propagation of the sound in a stratified environment. Keywords: Ray Tracing / Stratified / Moving Medum / Aurization / Open-Source â © P. For the same reason, the advanced of ray zoom does not give a benefit here. Here.

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