Showen, Robert L, and Sieracki To. “(54) ACOUSTICSURVEY METHODS IN WEAPONS LOCATION SYSTEMS,” n.d., 14.

Type Journal Article
Author Robert L Showen
Author Sieracki To
Abstract A Survey method giving improvements in weapons fire loca ut1itooennd sSayvrssrttaeeymmissn iitsshddeiissmccilldoosssteeddo..fIImnnaaannnyuurbrubbiaalnndisSnyVgssstteetmmhawwtiibtlnhoaackddiisssittgrrniiabbl paths or create echoes, methods are provided to measure signal propagation. A Survey or tour of the covered region uses a moving signal source to probe propagation inside the region. Survey results may indicate where more or fewer sensors are needed. Survey results plus current measured noise gives prediction of instantaneous system sensitivity. In addition, multipath propagation may be used to determine a location even when only one or two sensors detect the signal. In Such exemplary cases, triangulation may be replaced or augmented by pattern recognition. Further, signals of the Survey need not be acoustic impulses such as gunfire, but may be RF signals, or coded continuous signals so that gunfire-like Sounds would not disturb citizens in the area.
Language en
Pages 14
Library Catalog Zotero
Date Added 6/4/2019, 6:31:58 PM
Modified 6/4/2019, 6:31:58 PM

Attachments

- Showen and To - (54) ACOUSTICSURVEY METHODS IN WEAPONS LOCATION SY.pdf

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“0 -- Acoustical Characterization of Gunshots -- Maher_ieeesafe_0407_prezo.Pdf.” Accessed November 15, 2017. http://www.montana.edu/rmaher/publications/maher_ieeesafe_0407_prezo.pdf.

Type Attachment
Accessed 11/15/2017, 7:33:37 PM
URL http://www.montana.edu/rmaher/publications/maher_ieeesafe_0407_prezo.pdf
Date Added 11/15/2017, 7:33:37 PM
Modified 11/28/2017, 9:34:01 AM

- Item has no authors

“1 -- Acoustical Characterization of Gunshots -- Maher_ieeesafe_0407_109-113.Pdf.” Accessed November 15, 2017. http://www.montana.edu/rmaher/publications/maher_ieeesafe_0407_109-113.pdf.

Type Attachment
Accessed 11/15/2017, 7:33:59 PM
URL http://www.montana.edu/rmaher/publications/maher_ieeesafe_0407_109-113.pdf
Date Added 11/15/2017, 7:33:59 PM
Modified 11/28/2017, 9:33:20 AM

- Item has no authors

“2 -- Forensic Gunshot Acoustic Analysis Is Heating Up. Don’t Get Burned.” Forensic Magazine, October 18, 2012. https://www.forensicmag.com/article/2012/10/forensic-gunshot-acoustic-analysis-heating-dont-get-burned.

Type Web Page
Abstract Gunshot acoustics hold plenty of investigative promise, but analysis can be difficult even for experts.
Accessed 11/28/2017, 10:00:19 AM
Date 2012-10-18T10:31:00-04:00
URL https://www.forensicmag.com/article/2012/10/forensic-gunshot-acoustic-analysis-heating-dont-get-burned
Date Added 11/28/2017, 10:00:19 AM
Modified 11/28/2017, 10:00:43 AM

Attachments

- Snapshot

Quality report

- Item has no authors

“8 -- The Acoustics of Gunfire -- INCE06_gunshot.Pdf.” Accessed November 28, 2017. http://audioforensics.com/PDFs/INCE06_gunshot.pdf.

Type	Attachment
Accessed	11/28/2017, 11:20:47 AM
URL	http://audioforensics.com/PDFs/INCE06_gunshot.pdf
Date Added	11/28/2017, 11:20:47 AM
Modified	11/28/2017, 11:21:32 AM

- Item has no authors

Ouellette, Jennifer, and Jennifer Ouellette. “A Shot in the Dark: The Acoustics of Gunfire.” Scientific American Blog Network. Accessed October 24, 2017. https://blogs.scientificamerican.com/cocktail-party-physics/a-shot-in-the-dark-the-acoustics-of-gunfire/.

Type	Web Page
Author	Jennifer Ouellette
Author	Jennifer Ouellette
Accessed	10/24/2017, 11:00:11 AM
URL	https://blogs.scientificamerican.com/cocktail-party-physics/a-shot-in-the-dark-the-acoustics-of-gunfire/
Short Title	A Shot in the Dark
Date Added	10/24/2017, 11:00:11 AM
Modified	10/24/2017, 11:00:11 AM

Attachments

- Snapshot

Ramos, António L. L., Sverre Holm, Sigmund Gudvangen, and Ragnvald Otterlei. “A Spectral Subtraction Based Algorithm for Real-Time Noise Cancellation with Application to Gunshot Acoustics.” International Journal of Electronics and Telecommunications 59, no. 1 (March 1, 2013): 93–98. https://doi.org/10.2478/eletel-2013-0011.

Type	Journal Article
Author	António L. L. Ramos
Author	Sverre Holm
Author	Sigmund Gudvangen
Author	Ragnvald Otterlei
Abstract	This paper introduces an improved spectral subtraction based algorithm for real-time noise cancellation, applied to gunshot acoustical signals. The derivation is based on the fact that, in practice, relatively long periods without gunshot signals occur and the background noise can be modeled as being short-time stationary and uncorrelated to the impulsive gunshot signals. Moreover, gunshot signals, in general, have a spiky autocorrelation while typical vehicle noise, or related, is periodic and exhibits a wider autocorrelation. The Spectral Suppression algorithm is applied using the pre-filtering approach, as opposed to post-filtering which requires a priori knowledge of the direction of arrival of the signals of interest, namely, the Muzzle blast and the Shockwave. The results presented in this work are based on a dataset generated by combining signals from real gunshots and real vehicle noise.
Accessed	10/20/2018, 5:49:44 PM
Publication	International Journal of Electronics and Telecommunications
Date	2013-03-1
URL	http://content.sciendo.com/view/journals/eletel/59/1/article-p93.xml
Volume	59
Language	en
Issue	1
Pages	93-98
ISSN	0867-6747
Library Catalog	Crossref
DOI	10.2478/eletel-2013-0011
Date Added	10/20/2018, 5:49:44 PM
Modified	6/6/2019, 10:31:56 AM

Tags:

gunshot acoustics[2], noise cancellation, spectral subtraction

Attachments

- Ramos et al. - 2013 - A Spectral Subtraction Based Algorithm for Real-ti.pdf
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Peterson, Scott, and Paul Schomer. “Acoustic Analysis of Small Arms Fire:” Fort Belvoir, VA: Defense Technical Information Center, January 1, 1994. https://doi.org/10.21236/ADA278306.

Type	Report
Author	Scott Peterson
Author	Paul Schomer
Accessed	6/4/2019, 10:04:08 AM
Date	1994-1-1
URL	http://www.dtic.mil/docs/citations/ADA278306
Place	Fort Belvoir, VA
Short Title	Acoustic Analysis of Small Arms Fire
Language	en
Extra	DOI: 10.21236/ADA278306
Library Catalog	Crossref
Date Added	6/4/2019, 10:04:08 AM
Modified	6/6/2019, 10:31:33 AM

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- Peterson and Schomer - 1994 - Acoustic Analysis of Small Arms Fire.pdf
- Peterson and Schomer - 1994 - Acoustic Analysis of Small Arms Fire.pdf

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“Acoustic Analysis of Sound: Spectral Analysis.” Accessed November 23, 2017. http://clas.mq.edu.au/speech/acoustics/frequency/spectral.html.

Type	Web Page
Accessed	11/23/2017, 7:18:36 PM
URL	http://clas.mq.edu.au/speech/acoustics/frequency/spectral.html
Date Added	11/23/2017, 7:18:36 PM
Modified	11/23/2017, 7:18:36 PM

Attachments

- Acoustic Analysis of Sound: Spectral analysis

Quality report

- Item has no authors

Guida, Heraldo Lorena, Thiago Hernandes Diniz, and Sérgio Koodi Kinoshita. “Acoustic and Psychoacoustic Analysis of the Noise Produced by the Police Force Firearms.” Brazilian Journal of Otorhinolaryngology 77, no. 2 (April 2011): 163–70. https://doi.org/10.1590/S1808-86942011000200005.

Type	Journal Article
Author	Heraldo Lorena Guida
Author	Thiago Hernandes Diniz
Author	Sérgio Koodi Kinoshita
Accessed	11/23/2017, 7:24:49 PM
Publication	Brazilian Journal of Otorhinolaryngology
Date	04/2011
URL	http://www.scielo.br/scielo.php?script=sci_abstract&pid=S1808-86942011000200005&lng=en&nrm=iso&tlng=en
Volume	77
Issue	2
Pages	163-170
ISSN	1808-8694
Library Catalog	SciELO
DOI	10.1590/S1808-86942011000200005
Date Added	11/23/2017, 7:24:49 PM
Modified	11/23/2017, 7:24:49 PM

Attachments

- Full Text PDF
- Snapshot

“Acoustic and Psychoacoustic Analysis of the Noise Produced by the Police Force Firearms | Elsevier Enhanced Reader.” Accessed June 4, 2019. https://doi.org/10.1590/S1808-86942011000200005.

Type Web Page
Accessed 6/4/2019, 5:53:24 PM
URL https://reader.elsevier.com/reader/sd/pii/S1808869415308053?token=CC7C2975857DA52E8F9AF6819A87E21B904A2B94F89E513E035A4DCEC6EF6AD7211243EAC301F50CC1C9A494573F1949
Language en
Extra DOI: 10.1590/S1808-86942011000200005
Date Added 6/4/2019, 5:53:24 PM
Modified 6/4/2019, 5:53:24 PM

Attachments

- Acoustic and psychoacoustic analysis of the noise produced by the police force.pdf
- Snapshot

Quality report

- Item has no authors

Duckworth, Gregory L., James E. Barger, and Douglas C. Gilbert. Acoustic counter-sniper system. US6178141 B1, filed May 28, 1999, and issued January 23, 2001. http://www.google.com/patents/US6178141.

Type Patent
Inventor Gregory L. Duckworth
Inventor James E. Barger
Inventor Douglas C. Gilbert
Abstract A low cost and highly accurate sniper detection and localization system uses observations of the shock wave from supersonic bullets to estimate the bullet trajectory, Mach number, and caliber. If available, muzzle blast observations from an unsilenced firearm is used to estimate the exact sniper location along the trajectory. The system may be fixed or portable and may be wearable on a user's body. The system utilizes a distributed array of acoustic sensors to detect the projectile's shock wave and the muzzle blast from a firearm. The detection of the shock wave and muzzle blast is used to measure the wave arrival times of each waveform type at the sensors. This time of arrival (TOA) information for the shock wave and blast wave are used to determine the projectile's trajectory and a line of bearing to the origin of the projectile. A very accurate model of the bullet ballistics and acoustic radiation is used which includes bullet deceleration. This allows the use of very flexible acoustic sensor types and placements, since the system can model the bullet's flight, and hence the acoustic observations, over a wide area very accurately. System sensor configurations can be as simple as two small three element tetrahedral microphone arrays on either side of the area to be protected or six omnidirectional microphones spread over the area to be monitored. Sensors may also be monitored to a helmet as used with the wearable system. Sensor nodes provide information to a command node via wireless network telemetry or hardwired cables for the command node comprising a computer to effect processing and display.
Accessed 12/1/2017, 10:57:10 AM
URL http://www.google.com/patents/US6178141
Country United States
Assignee Gte Internetworking Incorporated
Filing Date 1999-05-28 May 28, 1999
Extra U.S. Classification 367/127, 367/124, 367/906; International Classification F41H11/00, G01S3/808, G01S5/20; Cooperative Classification Y10S367/906, F41H11/00, G01S3/8083, G01S5/20; European Classification F41H11/00, G01S5/20, G01S3/808B
Date Added 12/1/2017, 10:57:10 AM
Modified 6/6/2019, 10:26:49 AM

Tags:

data[2], shock[2], system[3], trajectory[2], wave[2]

Notes:

Classifications

F41H11/00: Defence installations; Defence devices
G01S3/8083: Systems for determining direction or deviation from predetermined direction using transducers spaced apart and measuring phase or time difference between signals therefrom, i.e. path-difference systems determining direction of source
G01S5/20: Position of source determined by a plurality of spaced direction-finders
Y10S367/906: Airborne shock-wave detection

Attachments

- Duckworth et al_2001_Acoustic counter-sniper system.pdf
- Google Patents PDF

Duckworth, Gregory L., Douglas C. Gilbert, and James E. Barger. “Acoustic Counter-Sniper System.” edited by Edward M. Carapezza and Donald Spector, 262–75, 1997. https://doi.org/10.1117/12.266747.

Type Conference Paper
Author Gregory L. Duckworth
Author Douglas C. Gilbert
Author James E. Barger
Editor Edward M. Carapezza
Editor Donald Spector
Abstract A low cost and highly accurate Sniper detection and local ization System uses observations of the Shock wave from SuperSonic bullets to estimate the bullet trajectory, Mach number, and caliber. If available, muzzle blast observations from an unsilenced firearm is used to estimate the exact Sniper location along the trajectory. The System may be fixed or portable and may be wearable on a user's body. The System utilizes a distributed array of acoustic Sensors to detect the projectile's shock wave and the muzzle blast from a firearm. The detection of the shock wave and muzzle blast is used to measure the wave arrival times of each waveform type at the sensors. This time of arrival (TOA) information for the shock wave and blast wave are used to determine the projectile's trajectory and a line of bearing to the origin of the projectile. A very accurate model of the bullet ballistics and acoustic radiation is used which includes bullet decel eration. This allows the use of very flexible acoustic sensor types and placements, Since the System can model the bullet's flight, and hence the acoustic observations, over a wide area very accurately. System Sensor configurations can be as simple as two Small three element tetrahedral micro phone arrays on either Side of the area to be protected or Six omnidirectional microphones spread over the area to be monitored. Sensors may also be monitored to a helmet as used with the wearable system. Sensor nodes provide infor mation to a command node Via wireleSS network telemetry or hardwired cables for the command node comprising a computer to effect processing and display.
Accessed 6/20/2018, 3:11:23 PM
Date 1997-2-18
URL http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1026044
Language en
Pages 262-275
Library Catalog Crossref
DOI 10.1117/12.266747
Date Added 6/20/2018, 3:11:23 PM
Modified 6/6/2019, 10:26:57 AM

Attachments

- Duckworth et al. - 1997 - Acoustic counter-sniper system.pdf
- Duckworth et al. - 1997 - Acoustic counter-sniper system.pdf

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Duckworth, Gregory L., James E. Barger, and Douglas C. Gilbert. Acoustic counter-sniper system. United States US5930202A, filed November 19, 1997, and issued July 27, 1999. https://patents.google.com/patent/US5930202A/en.

Type Patent
Inventor Gregory L. Duckworth
Inventor James E. Barger
Inventor Douglas C. Gilbert
Abstract A low cost and highly accurate sniper detection and localization system uses observations of the shock wave from supersonic bullets to estimate the bullet trajectory, Mach number, and caliber. If available, muzzle blast observations from an unsilenced firearm is used to estimate the exact sniper location along the trajectory. The system utilizes a distributed array of acoustic sensors to detect the leading edge of a projectile's shock wave and the muzzle blast from a firearm. The detection of the shock wave and muzzle blast is used to measure the wave arrival times of each waveform type at the sensors. This time of arrival (TOA) information for the shock wave and blast wave are used to determine the projectile's trajectory and a line of bearing to the origin of the projectile. A very accurate model of the bullet ballistics and acoustic radiation is used which includes bullet deceleration. This allows the use of very flexible acoustic sensor types and placements, since the system can model the bullet's flight, and hence the acoustic observations, over a wide area very accurately. System sensor configurations can be as simple as two small three element tetrahedral microphone arrays on either side of the area to be protected, or six omnidirectional microphones spread over the area to be monitored. Sensor nodes provide information to a Command node via wireless network telemetry or hardwired cables for the Command Node comprising a computer to effect processing and display.
Accessed 6/22/2018, 4:39:09 PM
URL https://patents.google.com/patent/US5930202A/en
Country US
Assignee Genuity Inc
Issuing Authority United States
Filing Date 1997-11-19 1997-11-19
Application Number US08974657
Date Added 6/14/2018, 4:00:22 AM
Modified 6/6/2019, 10:26:31 AM

Tags:

blast, shock^{2}, time^{4}, trajectory^{2}, wave^{2}

Notes:

Classifications

G01S5/20: Position of source determined by a plurality of spaced direction-finders
G01S5/18: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves
Y10S367/906: Airborne shock-wave detection

Classifications

G01S5/20: Position of source determined by a plurality of spaced direction-finders
G01S5/18: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves
Y10S367/906: Airborne shock-wave detection

Classifications

G01S5/20: Position of source determined by a plurality of spaced direction-finders
G01S5/18: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves
Y10S367/906: Airborne shock-wave detection

README

Attachments

- Duckworth et al_1999_Acoustic counter-sniper system.pdf
- Duckworth et al_1999_Acoustic counter-sniper system.pdf
- Duckworth et al_1999_Acoustic counter-sniper system.pdf

Levanon, Nadav. Acoustic hit indicator. United States US5920522A, filed July 7, 1997, and issued July 6, 1999. https://patents.google.com/patent/US5920522A/en?oq=7%2c359%2c285.

Type	Patent
Inventor	Nadav Levanon
Accessed	6/14/2018, 3:59:31 AM
URL	https://patents.google.com/patent/US5920522A/en?oq=7%2c359%2c285
Country	US
Language	en
Assignee	Levanon; Nadav
Issuing Authority	United States
Filing Date	1997-07-07 1997-07-07
Application Number	US08889149
Date Added	6/14/2018, 3:59:31 AM
Modified	6/14/2018, 3:59:31 AM

Tags:

incidence, plane, sensors[3], target, time[4]

Notes:

Classifications

G01S5/28: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves by co-ordinating position lines of different shape, e.g. hyperbolic, circular, elliptical, radial
G01S5/18: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves
Y10S367/906: Airborne shock-wave detection

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- Levanon_1999_Acoustic hit indicator.pdf

Showen, Robert L., Robert B. Calhoun, and Jason W. Dunham. Acoustic location of gunshots using combined angle of arrival and time of arrival measurements. US7474589 B2, filed October 10, 2006, and issued January 6, 2009. http://www.google.com/patents/US7474589.

Type Patent
Inventor Robert L. Showen
Inventor Robert B. Calhoun
Inventor Jason W. Dunham
Abstract A gunshot location system computes candidate gunshot locations [314] from angle-of-arrival information [304, 308] and time-of-arrival information [312] provided by acoustic sensors [300, 302]. In addition to an angle, each sensor calculates an angular uncertainty [306, 310] from impulses received at four or more microphones having rotational symmetry. An intersection of one or more time-of-arrival hyperbolas with one or more angle-of-arrival beams [322] is used to determine a candidate gunshot location. In simple environments, a location can be confirmed with just two sensors allowing sensor density to be significantly reduced, while in complex environments including reflections, blocking, and interfering acoustic events, the additional angle-of-arrival information improves location accuracy and confidence, allowing elimination of candidate locations inconsistent with the combined time-of-arrival and angle-of-arrival information.
Accessed 10/24/2017, 11:31:25 AM
URL http://www.google.com/patents/US7474589
Country United States
Assignee Shotspotter, Inc.
Filing Date 2006-10-10 Oct 10, 2006
Extra U.S. Classification 367/127; International Classification G01S3/80; Cooperative Classification G01S5/28, G01S5/18; European Classification G01S5/18, G01S5/28
Date Added 10/24/2017, 11:31:25 AM
Modified 10/24/2017, 11:31:25 AM

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- Google Patents PDF

"Acoustic Sensors.Pdf." Accessed November 15, 2017. http://www.realtechsupport.org/UB/MRII/docs/sensing/Acoustic%20Sensors.pdf.

Type Attachment
Accessed 11/15/2017, 7:37:53 PM
URL http://www.realtechsupport.org/UB/MRII/docs/sensing/Acoustic%20Sensors.pdf
Date Added 11/15/2017, 7:37:53 PM
Modified 11/15/2017, 7:37:53 PM

- Item has no authors

Sallai, János, Ákos Lédeczi, and Péter Völgyesi. "Acoustic Shooter Localization with a Minimal Number of Single-Channel Wireless Sensor Nodes," 96. ACM Press, 2011. https://doi.org/10.1145/2070942.2070953.

Type Conference Paper
Author János Sallai
Author Ákos Lédeczi
Author Péter Völgyesi
Abstract Acoustic shooter localization systems are being rapidly deployed in the field. However, these are standalone systems—either wearable or vehicle-mounted—that do not have networking capability even though the advantages of widely distributed sensing for locating shooters have been demonstrated before. The reason for this is that certain disadvantages of wireless network-based prototypes made them impractical for the military. The system that utilized stationary single-channel sensors required many sensor nodes, while the multi-channel wearable version needed to track the absolute self-orientation of the nodes continuously, a notoriously hard task. This paper presents an approach that overcomes the shortcomings of past approaches. Specifically, the technique requires as few as five single-channel wireless sensors to provide accurate shooter localization and projectile trajectory estimation. Caliber estimation and weapon classification are also supported. In addition, a single node alone can provide reliable miss distance and range estimates based on a single shot as long as a reasonable assumption holds. The main contribution of the work and the focus of this paper is the novel sensor fusion technique that works well with a limited number of observations. The technique is thoroughly evaluated using an extensive shot library.
Accessed 6/14/2018, 10:19:27 PM
Date 2011
Publisher ACM Press
URL http://dl.acm.org/citation.cfm?doid=2070942.2070953
Language en
Pages 96
Library Catalog Crossref
ISBN 978-1-4503-0718-5
DOI 10.1145/2070942.2070953
Date Added 6/14/2018, 10:19:27 PM
Modified 6/6/2019, 10:32:10 AM

Attachments

- Sallai et al. - 2011 - Acoustic shooter localization with a minimal numbe.pdf

  Contents

- Sallai et al. - 2011 - Acoustic shooter localization with a minimal numbe.pdf

  Contents

  Introduction
  Related Work
  Single Sensor Approach
  Networked Operation
  Sensor Fusion Overview
  Initial shooter localization
  Projectile trajectory estimation
  Final shooter localization
  Caliber and weapon classification
  Projectile classification
  Weapon classification
  Evaluation
  Error sensitivity to sensor position error
  Conclusion
  Acknowledgements
  References

- Sallai et al. - 2011 - Acoustic shooter localization with a minimal numbe.pdf

  Contents

  Introduction
  Related Work
  Single Sensor Approach
  Networked Operation
  Sensor Fusion Overview
  Initial shooter localization
  Projectile trajectory estimation
  Final shooter localization
  Caliber and weapon classification
  Projectile classification
  Weapon classification
  Evaluation
  Error sensitivity to sensor position error
  Conclusion
  Acknowledgements
  References

Lédeczi, Ákos, Miklós Maróti, Gyula Simon, and György Balogh. Acoustic source localization system and applications of the same. US7433266 B2, filed September 15, 2005, and issued October 7, 2008. http://www.google.com/patents/US7433266.

Type Patent
Inventor Ákos Lédeczi
Inventor Miklós Maróti
Inventor Gyula Simon
Inventor György Balogh
Abstract A system for locating an acoustic source from an acoustic event of the acoustic source. In one embodiment, the system includes a sensor network having a plurality of spatially separated sensor nodes each located in a predetermined position encountering acoustic waves generated by an acoustic event passing proximate to the plurality of spatially separated sensor nodes, where the plurality of spatially separated sensor nodes are synchronized to a common time base such that when the acoustic event is detected, information of the acoustic waves from each of the plurality of spatially separated sensor nodes is obtained and broadcasted through the sensor network. The system further includes a base station for receiving information of the acoustic waves broadcasted from the sensor network and processing the received information of the acoustic waves so as to locate the acoustic source of the acoustic event.
Accessed 12/1/2017, 10:59:18 AM
URL http://www.google.com/patents/US7433266
Country United States
Assignee Vanderbilt University
Filing Date 2005-09-15 Sep 15, 2005
Extra U.S. Classification 367/129, 367/906, 367/127; International Classification G01S3/80; Cooperative Classification G01S5/22, G01S5/0081, Y10S367/906; European Classification G01S5/00R4, G01S5/22
Date Added 12/1/2017, 10:59:18 AM
Modified 6/6/2019, 10:28:50 AM

Tags:

acoustic[7], node, nodes, sensor[3], time[4]

Notes:

Classifications

G01S5/0081: Transmission between base stations
G01S5/22: Position of source determined by co-ordinating a plurality of position lines defined by path-difference measurements
Y10S367/906: Airborne shock-wave detection

README

Attachments

- Google Patents PDF
- Lédeczi et al_2008_Acoustic source localization system and applications of the same.pdf

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"Acoustic_Characterization_of_41_Cooper_Square_Academic_Spaces0.Pdf." Accessed November 15, 2017. https://engfac.cooper.edu/pages/melody/uploads/Acoustic_Characterization_of_41_Cooper_Square_Academic_Spaces0.pdf.

Type Attachment
Accessed 11/15/2017, 7:34:53 PM
URL https://engfac.cooper.edu/pages/melody/uploads/Acoustic_Characterization_of_41_Cooper_Square_Academic_Spaces0.pdf
Date Added 11/15/2017, 7:34:53 PM
Modified 11/15/2017, 7:34:53 PM

- Item has no authors

"Acoustic-Eyes-a-Novel-Sound-Source-Localization-and-Monitoring-Technique-with-3D-Sound.Pdf." Accessed January 4, 2018. http://microflown-maritime.com/wp-content/uploads/2014/02/Acoustic-eyes-a-novel-sound-source-localization-and-monitoring-technique-with-3D-sound.pdf.

Type Attachment
Accessed 1/4/2018, 11:17:02 AM
URL http://microflown-maritime.com/wp-content/uploads/2014/02/Acoustic-eyes-a-novel-sound-source-localization-and-monitoring-technique-with-3D-sound.pdf
Date Added 1/4/2018, 11:17:02 AM
Modified 1/4/2018, 11:17:02 AM

- Item has no authors

Maher, Robert C. "Acoustical Characterization of Gunshots," 2007, 5.

Type Journal Article
Author Robert C Maher
Abstract This paper addresses several practical and theoretical issues encountered in the analysis of gunshot audio recordings. Gunshot recordings have the potential for both tactical detection and forensic evaluation. Such recordings can provide information about speed and trajectory of the projectile, the estimated location of the shooter, and in some cases the type of firearm and ammunition used. However, audio recordings of gunshots typically contain background noise and reverberation due to the gunshot sound reflecting off and diffracting around nearby surfaces, and these effects may limit the reliability of the acoustic estimates. Recordings obtained under carefully controlled conditions are used to demonstrate several key features and limitations of acoustic gunshot analysis.
Date 2007
Language en
Pages 5
Library Catalog Zotero
Date Added 6/13/2018, 5:12:32 PM
Modified 6/6/2019, 10:29:34 AM

Notes:

technical, trigonometry

A very good first_paper

Attachments

- Maher - 2007 - Acoustical Characterization of Gunshots.pdf
- Maher - Acoustical Characterization of Gunshots.pdf

Contents

Maher, Robert C. "Acoustical Modeling of Gunshots Including Directional Information and Reflections." New York, 2011, 7.

Type Journal Article
Author Robert C Maher
Abstract Audio recordings of gunshots exhibit acoustical properties that depend upon the geometry and acoustical characteristics of nearby reflecting surfaces and the relative orientation of the firearm with respect to the recording microphone. Prior empirical studies have demonstrated the basic principles of gunshot recordings near the firearm and near the target. This paper describes an experiment to model the directional characteristics and reflections of several firearm types for a set of test configurations. The results show that reflections and reverberation can be a significant portion of the total acoustic energy received at the microphone.
Publication New York
Date 2011
Language en
Pages 7
Library Catalog Zotero
Date Added 6/13/2018, 5:55:19 PM
Modified 6/6/2019, 10:29:37 AM

Attachments

- Maher - 2011 - Acoustical modeling of gunshots including directio.pdf
- Maher - 2011 - Acoustical modeling of gunshots including directio.pdf
- Maher - Acoustical Modeling of Gunshots Including Directio.pdf

Contents

- Maher - Acoustical Modeling of Gunshots Including Directio.pdf

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Acoustical Modeling of Gunshots Including Directional Information and Reflections
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Gunshot Evidence IssuesNear the Shooter
Supersonic Projectile
Example Recording
Ground Reflection (cont.)
Directional Effects
Directional Effects (cont.)
Different Firearms On-Axis
Sound Level vs. Azimuth
Effects Due to Surroundings
Anechoic Recording On-Axis
Anechoic Recording 20 deg
Example “alley” scenario
Model Result: Barrel to West
Model Result: Barrel to East
Recommendations
Conclusions
Thank you for your attention.

“Acoustician_Charles_D__Ross.Pdf.” Accessed January 14, 2019. http://scvcamp868.webstarts.com/uploads/Acoustician_Charles_D__Ross.pdf.

Type Attachment
Accessed 1/14/2019, 7:40:15 PM
URL http://scvcamp868.webstarts.com/uploads/Acoustician_Charles_D__Ross.pdf
Date Added 1/14/2019, 7:40:15 PM
Modified 1/14/2019, 7:40:15 PM

- Item has no authors

“Acoustics - Do Low Frequency Sounds Really Carry Longer Distances? - Physics Stack Exchange.” Accessed November 22, 2017. https://physics.stackexchange.com/questions/87751/do-low-frequency-sounds-really-carry-longer-distances.

Type Web Page
Accessed 11/22/2017, 2:03:21 PM
URL https://physics.stackexchange.com/questions/87751/do-low-frequency-sounds-really-carry-longer-distances
Short Title acoustics - Do low frequency sounds really carry longer distances?
Date Added 11/22/2017, 2:03:21 PM
Modified 11/22/2017, 2:03:21 PM

Attachments

- Snapshot

Quality report

- Item has no authors

“Acoustics FAQ.” Accessed June 14, 2018. http://newt.phys.unsw.edu.au/jw/musFAQ.html.

Type Web Page
Accessed 6/14/2018, 12:04:03 AM
URL http://newt.phys.unsw.edu.au/jw/musFAQ.html
Date Added 6/14/2018, 12:04:03 AM
Modified 6/14/2018, 12:04:03 AM

Attachments

- Acoustics FAQ

Quality report

- Item has no authors

“Acoustics of Gunfire -- Internoise 2006.Pdf,” n.d.

- Item has no authors

“Acoustics of Speech and Hearing, Spectrograms.Pdf.” Accessed November 23, 2017. http://www.phon.ucl.ac.uk/courses/spsci/acoustics/week1-10.pdf.

Type Attachment
Accessed 11/23/2017, 1:14:22 PM
URL http://www.phon.ucl.ac.uk/courses/spsci/acoustics/week1-10.pdf
Date Added 11/23/2017, 1:14:22 PM
Modified 6/8/2019, 12:48:03 PM

- Item has no authors

Maher, Robert C, and Tushar Kanti Routh. “Advancing Forensic Analysis of Gunshot Acoustics.” New York, 2015, 8.

Type Journal Article
Author Robert C Maher
Author Tushar Kanti Routh
Abstract This paper describes our current work to create the apparatus and methodology for scientific and repeatable collection of firearm acoustical properties, including the important direction-dependence of each firearm’s sound field. Gunshot acoustical data is collected for a wide range of firearms using an elevated shooting platform and an elevated spatial array of microphones to allow echo-free directional recordings of each firearm’s muzzle blast. The results of this proposed methodology include a standard procedure for cataloging firearm acoustical characteristics, and a database of acoustical signatures as a function of azimuth for a variety of common firearms and types of ammunition.
Publication New York
Date 2015
Language en
Pages 8
Library Catalog Zotero
Date Added 6/13/2018, 5:53:15 PM
Modified 6/6/2019, 10:29:46 AM

Attachments

- Maher and Routh - 2015 - Advancing Forensic Analysis of Gunshot Acoustics.pdf

Contents

- Maher and Routh - 2015 - Advancing Forensic Analysis of Gunshot Acoustics.pdf

Contents

Advancing Forensic Analysis of Gunshot Acoustics
ABSTRACT
1. Introduction
1.1. Research issues for gunshot acoustics
1.2. Gunshot research goals
2. Gunshot audio forensic information
2.1. Muzzle blast
2.2. Supersonic Projectile
2.3. Directionality of gunshots
2.4. Reflections and reverberation
2.5. Gunshot acoustical characterization
3. proposed gunshot recording system and methodology
3.1. Prior demonstration experiment
3.2. Proposed gunshot recording configuration
3.3. Preliminary test progress
4. Conclusion
5. acknowledgements
6. REFERENCES

O. Stearman, Ronald, Glen H. Schulze, and Stuart M. Rohre. “Aircraft Damage Detection from Acoustic and Noise Impressed Signals Found by a Cockpit Voice Recorder.” Acoustical Society of America Journal 101 (May 1, 1997): 3085. https://doi.org/10.1121/1.418804.

Type Journal Article
Author Ronald O. Stearman
Author Glen H. Schulze
Author Stuart M. Rohre

Abstract Currently, research is being conducted to detect damage through structural acoustics,signal processing, and transducer designs. The present study illustrates that damage detection may be carried out with an existing system acting as a latent signal transducer. One example involved a reliability problem in a commuter liner aircraft engine mount design where undetected crack growth created a critical whirl flutter condition destroying the aircraft. This reliability problem prompted the need for an in-place damage detection system to identify critical engine mount conditions. Signal analysis of data acquired by a cockpit voice recorder prior to and during the catastrophic aircraft whirl flutter event provided insight into critical signals that indicated the failure onset. Although regularly scheduled inspections failed to detect the problem, cockpit voice recorder signals contained a dynamic signature of this damage feature throughout the duration of the tape. It is highly probable that this damage signature existed for a much longer period of time, but due to the endless loop configuration of the cockpit voice recorder the earlier data were erased. The study indicated that even in the case of an unused cockpit voice recorder track, careful signal processing can extract surprising details about detecting potential damage. [See NOISE-CON Proceedings for full paper.]

Publication Acoustical Society of America Journal
Date May 1, 1997
Volume 101
Pages 3085
Library Catalog ResearchGate
DOI 10.1121/1.418804
Date Added 11/28/2017, 10:08:19 AM
Modified 11/28/2017, 10:08:19 AM

Attachments

- ResearchGate Link

Beck, Steven D., Hirotaka Nakasone, and Kenneth W. Marr. "An Introduction to Forensic Gunshot Acoustics." The Journal of the Acoustical Society of America 130, no. 4 (October 2011): 2519–2519. https://doi.org/10.1121/1.3655043.

Type Journal Article
Author Steven D. Beck
Author Hirotaka Nakasone
Author Kenneth W. Marr
Accessed 12/4/2018, 4:27:59 PM
Publication The Journal of the Acoustical Society of America
Date 10/2011
URL http://asa.scitation.org/doi/10.1121/1.3655043
Volume 130
Language en
Issue 4
Pages 2519-2519
ISSN 0001-4966
Library Catalog Crossref
DOI 10.1121/1.3655043
Date Added 12/4/2018, 4:27:59 PM
Modified 6/6/2019, 10:25:02 AM

Attachments

- An_introduction_to_forensic_gunshot_acoustics.pdf
- Beck et al. - 2011 - An introduction to forensic gunshot acoustics.pdf

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"AUDIO EVENT DETECTION FROM ACOUSTIC UNIT OCCURRENCE PATTERNS -- Eventdet.Pdf." Accessed November 15, 2017. http://mlsp.cs.cmu.edu/people/rsingh/docs/eventdet.pdf.

Type Attachment
Accessed 11/15/2017, 7:42:09 PM
URL http://mlsp.cs.cmu.edu/people/rsingh/docs/eventdet.pdf
Date Added 11/15/2017, 7:42:09 PM
Modified 11/28/2017, 9:29:36 AM

- Item has no authors

Shelley, Simon Benedict, Damian Thomas Murphy, and Andrew James Chadwick. "B-Format Acoustic Impulse Response Measurement and Analysis In the Forest at Koli National Park, Finland," 2013, 6.

Type Journal Article
Author Simon Benedict Shelley
Author Damian Thomas Murphy
Author Andrew James Chadwick
Abstract Acoustic impulse responses are used for convolution based auralisation and reverberation techniques for a range of applications, such as music production, sound design and virtual reality systems. These impulse responses can be measured in real world environments to provide realistic and natural sounding reverberation effects. Analysis of this data can also provide useful information about the acoustic characteristics of a particular space. Currently, impulse responses recorded in outdoor conditions are not widely available for surround sound auralisation and research purposes. This work presents results from a recent acoustic survey of measurements at three locations in the snow covered forest of Koli National Park in Finland during early spring. Acoustic impulse responses were measured using a B-format Soundfield microphone and a single loudspeaker. The results are analysed in terms of reverberation and spatial characteristics. The work is part of a larger study to collect and investigate acoustic impulse responses from a variety of outdoor locations under different climatic conditions.

Date 2013
Language en
Pages 6
Library Catalog Zotero
Date Added 6/4/2019, 9:51:51 AM
Modified 6/4/2019, 9:51:51 AM

Attachments

- Shelley et al. - 2013 - B-Format Acoustic Impulse Response Measurement and.pdf

Contents

Korman, Murray S, and Antal A Sarkady. "Ballistic Shock Wave Localization Estimation of Shooter Position and Velocity Using Difference of Time of Arrival DTOA Algorithm in Orthogonally Arranged Discrete Acoustic Arrays" 19 (2013): 10.

Type Journal Article
Author Murray S Korman
Author Antal A Sarkady
Date 2013
Volume 19
Language en
Pages 10
Library Catalog Zotero
Date Added 6/4/2019, 6:21:47 PM
Modified 6/4/2019, 6:21:47 PM

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- Korman and Sarkady - 2013 - Ballistic shock wave localization estimation of sh.pdf

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"Basic Acoustics: Appendices," n.d., 10.

Type Journal Article
Language en
Pages 10
Library Catalog Zotero
Date Added 12/23/2018, 10:58:52 AM
Modified 12/23/2018, 10:58:52 AM

Attachments

- Basic Acoustics Appendices.pdf

Quality report

- Item has no authors

Damarla, Thyagaraju. Battlefield Acoustics. Cham: Springer International Publishing, 2015. https://doi.org/10.1007/978-3-319-16036-8.

Type Book
Author Thyagaraju Damarla
Accessed 6/18/2019, 9:45:05 AM
Date 2015

Publisher Springer International Publishing
URL http://link.springer.com/10.1007/978-3-319-16036-8
Place Cham
Language en
Extra DOI: 10.1007/978-3-319-16036-8
Library Catalog Crossref
ISBN 978-3-319-16035-1 978-3-319-16036-8
Date Added 6/18/2019, 9:45:05 AM
Modified 6/18/2019, 9:45:06 AM

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- Damarla - 2015 - Battlefield Acoustics.pdf

"Battlefield Acoustics Download." Accessed June 18, 2019. https://onlybooks.org/battlefield-acoustics-26398.

Type Web Page
Accessed 6/18/2019, 9:45:51 AM
URL https://onlybooks.org/battlefield-acoustics-26398
Extra 00000
Date Added 6/18/2019, 9:45:51 AM
Modified 6/18/2019, 9:45:51 AM

Attachments

- Battlefield Acoustics Download

Quality report

- Item has no authors

Morton, Kenneth D. "Bayesian Techniques for Adaptive Acoustic Surveillance," 2010, 250.

Type Journal Article
Author Kenneth D Morton
Date 2010
Language en
Pages 250
Library Catalog Zotero
Date Added 6/4/2019, 6:16:44 PM
Modified 6/4/2019, 6:16:44 PM

Attachments

- Morton - 2010 - Bayesian Techniques for Adaptive Acoustic Surveill.pdf

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Boersma, Paul. “Chapter 17: Acoustic Analysis,” n.d., 21.

Type	Journal Article
Author	Paul Boersma
Language	en
Pages	21
Library Catalog	Zotero
Date Added	6/8/2019, 5:28:56 PM
Modified	6/8/2019, 5:28:57 PM

Attachments

- Boersma - Chapter 17 Acoustic analysis.pdf

Riley, Dr John. “Defence Applications of High Frequency Acoustic Signal Processing to Countering Asymmetric Threats,” n.d., 22.

Type Journal Article
Author Dr John Riley
Language en
Pages 22
Library Catalog Zotero
Date Added 1/7/2019, 8:34:13 PM
Modified 1/7/2019, 8:34:13 PM

Attachments

- Riley - Defence applications of high frequency acoustic si.pdf

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Detection and classification of running vehicles based on acoustic signatures, issued October 3, 2008. https://patents.google.com/patent/US20090115635A1/en.

Type Patent
Abstract A method and apparatus for identifying running vehicles in an area to be monitored using acoustic signature recognition. The apparatus includes an input sensor for capturing an acoustic waveform produced by a vehicle source, and a processing system. The waveform is digitized and divided into frames. Each frame is filtered into a plurality of gammatone filtered signals. At least one spectral feature vector is computed for each frame. The vectors are integrated across a plurality of frames to create a spectro-temporal representation of the vehicle waveform. In a training mode, values from the spectro-temporal representation are used as inputs to a Nonlinear Hebbian learning function to extract acoustic signatures and synaptic weights. In an active mode, the synaptic weights and acoustic signatures are used as patterns in a supervised associative network to identify whether a vehicle is present in the area to be monitored. In response to a vehicle being present, the class of vehicle is identified. Results may be provided to a central computer.
Accessed 11/28/2017, 2:03:28 PM
URL https://patents.google.com/patent/US20090115635A1/en
Date Added 11/28/2017, 2:03:28 PM
Modified 11/28/2017, 2:03:28 PM

Attachments

- Snapshot

Quality report

- Item has no authors

Routh, Tushar, and Robert C Maher. “Determining the Muzzle Blast Duration and Acoustical Energy of Quasi-Anechoic Gunshot Recordings.” Los Angeles, 2016, 12.

Type Journal Article
Author Tushar Routh
Author Robert C Maher
Abstract Investigation of gunshot waveforms largely includes analyzing the muzzle blast. Generated by the combustion of gunpowder immediately after firing, these brief duration directional shock waves travel outward in all directions at the speed of sound. Features of these waveforms are analyzed to identify characteristics of a particular shot, for example, the combination of firearm type, ammunition, and orientation. This paper includes measured muzzle blast durations for several common firearms and calculation of the total acoustical energy during the muzzle blast period.
Publication Los Angeles
Date 2016
Language en
Pages 12
Library Catalog Zotero
Date Added 6/13/2018, 5:51:08 PM
Modified 6/6/2019, 10:32:03 AM

Attachments

- Routh and Maher - 2016 - Determining the muzzle blast duration and acoustic.pdf

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- Routh and Maher - 2016 - Determining the muzzle blast duration and acoustic.pdf

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4 Defining muzzle blast duration
4.1 Muzzle blast duration by waveform observation
4.2 Muzzle blast duration by energy accumulation
5 Methodology
5.1 Recording arrangement for gunshot signals
5.2 Orientation of twelve G.R.A.S. 40DP microphones
6 Firearm Types
7 Muzzle blast duration variation in different methods
8 Comparing waveform observation and energy accumulation methods
9 Energy accumulation for several firearms
10 Total acoustic energy variation for different firearms
11 CONCLUSIONS
12 ACKNOWLEDGEMENTS

“Engineering Acoustics/Outdoor Sound Propagation - Wikibooks, Open Books for an Open World.” Accessed November 22, 2017. https://en.wikibooks.org/wiki/Engineering_Acoustics/Outdoor_Sound_Propagation.

Type Web Page
Accessed 11/22/2017, 2:03:14 PM
URL https://en.wikibooks.org/wiki/Engineering_Acoustics/Outdoor_Sound_Propagation
Date Added 11/22/2017, 2:03:14 PM
Modified 6/6/2019, 10:35:01 AM

Attachments

- Engineering Acoustics/Outdoor Sound Propagation - Wikibooks, open books for an open world
- Engineering Acoustics/Outdoor Sound Propagation - Wikibooks, open books for an open world

Quality report

- Item has no authors

“Forensic Gunshot Acoustic Analysis Is Heating Up. Don’t Get Burned.” Forensic Magazine, October 18, 2012. https://www.forensicmag.com/article/2012/10/forensic-gunshot-acoustic-analysis-heating-dont-get-burned.

Type Web Page
Abstract Gunshot acoustics hold plenty of investigative promise, but analysis can be difficult even for experts.
Accessed 1/4/2018, 11:10:21 AM

Date 2012-10-18T10:31:00-04:00
URL https://www.forensicmag.com/article/2012/10/forensic-gunshot-acoustic-analysis-heating-dont-get-burned
Date Added 1/4/2018, 11:10:21 AM
Modified 1/4/2018, 11:10:21 AM

Attachments

- Snapshot

Quality report

- Item has no authors

Hansen, Professor Colin H. “FUNDAMENTALS OF ACOUSTICS.” Fundamentals of Acoustics, n.d., 30.

Type Journal Article
Author Professor Colin H Hansen
Publication Fundamentals of acoustics
Language en
Pages 30
Library Catalog Zotero
Date Added 12/23/2018, 10:58:43 AM
Modified 12/23/2018, 10:58:44 AM

Attachments

- Hansen - FUNDAMENTALS OF ACOUSTICS.pdf

Maher, Robert C, and Tushar K Routh. “Gunshot Acoustics: Pistol vs. Revolver,” 2017, 7.

Type Journal Article
Author Robert C Maher
Author Tushar K Routh
Abstract Audio forensic investigations may require interpretation of recordings containing gunshot sounds. These sounds are notable because of their impulsive nature: very high sound pressure and very short duration compared to other sounds relevant to forensic analysis. In this paper we examine the acoustical characteristics of muzzle blast sounds from two handguns: a Glock 19 pistol and a Ruger SP101 revolver. The muzzle blast sound of each handgun was recorded at several azimuth angles between 0 and 180 degrees with respect to the barrel using a quasi-anechoic methodology. Compared to the pistol, the revolver exhibits a more complicated acoustical pattern due to sound emanation from two sources: the cylinder-barrel gap and the muzzle.
Date 2017
Language en
Pages 7
Library Catalog Zotero
Date Added 6/13/2018, 5:38:50 PM
Modified 6/6/2019, 10:29:43 AM

Attachments

- Maher and Routh - 2017 - Gunshot Acoustics Pistol vs. Revolver.pdf

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- Maher and Routh - 2017 - Gunshot Acoustics Pistol vs. Revolver.pdf

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1 Introduction
2 Gunshot acoustics
3 Handguns: pistols and revolvers
4 Gunshot recordings
5 Glock 19 pistol
6 Ruger SP101 revolver
7 Discussion
  7.1 Azimuth near 0
  7.2 Azimuth near 90
  7.3 Azimuth near 180
8 Conclusions
9 Acknowledgements

"Introduction Ot Acoustic Analysis.Pdf," n.d.

- Item has no authors

Maher, Robert C. "Lending an Ear in the Courtroom: Forensic Acoustics," n.d., 9.

Type	Journal Article
Author	Robert C Maher
Language	en
Pages	9
Library Catalog	Zotero
Date Added	6/13/2018, 5:19:58 PM
Modified	6/13/2018, 5:19:58 PM

Notes:

Lay person

Include in top_level

Very casual reading, has a couple pictures of spectograms, covers court evidence.

Attachments

- Maher - Lending an Ear in the Courtroom Forensic Acoustic.pdf

---

Bickel, Brady R., Robert J. Cole, Megan J. Roberts, Bryan D. Glick, Jason A. Staph, David C. James, Gabriel D. Comi, and Stephen Schadler. Methods and apparatus for acoustic event detection. United States US9218728B2, filed February 2, 2012, and issued December 22, 2015. https://patents.google.com/patent/US9218728/en?oq=gunshot+audio+analysis.

Type	Patent
Inventor	Brady R. Bickel
Inventor	Robert J. Cole
Inventor	Megan J. Roberts
Inventor	Bryan D. Glick
Inventor	Jason A. Staph
Inventor	David C. James
Inventor	Gabriel D. Comi
Inventor	Stephen Schadler
Accessed	6/14/2018, 3:01:52 AM
URL	https://patents.google.com/patent/US9218728/en?oq=gunshot+audio+analysis
Country	US
Language	en
Assignee	Raytheon Co
Issuing Authority	United States
Filing Date	2012-02-02 2012-02-02
Application Number	US13364862
Date Added	6/14/2018, 3:01:54 AM
Modified	6/14/2018, 3:01:54 AM

Tags:

acoustic[7], event[3], gunshot[3], peak, step

Notes:

Classifications

G08B13/1672: Actuation by interference with mechanical vibrations in air or other fluid using passive vibration detection systems using sonic detecting means, e.g. a microphone operating in the audio frequency range
G01S5/20: Position of source determined by a plurality of spaced direction-finders
G01S5/22: Position of source determined by co-ordinating a plurality of position lines defined by path-difference measurements
G10H2210/00: Aspects or methods of musical processing having intrinsic musical character, i.e. involving musical theory or musical parameters or relying on musical knowledge, as applied in electrophonic musical tools or instruments
G10H2210/041: Musical analysis, i.e. isolation, extraction or identification of musical elements or musical parameters from a raw acoustic signal or from an encoded audio signal based on mfcc [mel -frequency spectral coefficients]
H04R2410/00: Microphones
H04R2499/11: Transducers incorporated or for use in hand-held devices, e.g. mobile phones, PDA's, camera's
H04R3/00: Circuits for transducers, loudspeakers or microphones

Attachments

- Bickel et al_2015_Methods and apparatus for acoustic event detection.pdf

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Maher, Robert. “Modeling and Signal Processing of Acoustic Gunshot Recordings.” In 2006 IEEE 12th Digital Signal Processing Workshop & 4th IEEE Signal Processing Education Workshop, 257–61. Teton National Park, WY, USA: IEEE, 2006. https://doi.org/10.1109/DSPWS.2006.265386.

Type	Conference Paper
Author	Robert Maher
Accessed	1/7/2019, 8:30:25 PM
Date	9/2006
Publisher	IEEE
URL	http://ieeexplore.ieee.org/document/4041069/
Place	Teton National Park, WY, USA
Language	en
Conference Name	2006 IEEE 12th Digital Signal Processing Workshop & 4th IEEE Signal Processing Education Workshop
Pages	257-261
Library Catalog	Crossref
ISBN	978-1-4244-0535-0
DOI	10.1109/DSPWS.2006.265386
Date Added	1/7/2019, 8:30:25 PM
Modified	6/6/2019, 10:29:29 AM

Attachments

- Maher - 2006 - Modeling and Signal Processing of Acoustic Gunshot.pdf
- Maher - 2006 - Modeling and Signal Processing of Acoustic Gunshot.pdf

Maher, Robert. “Modeling and Signal Processing of Acoustic Gunshot Recordings.” In 2006 IEEE 12th Digital Signal Processing Workshop & 4th IEEE Signal Processing Education Workshop, 257–61. Teton National Park, WY, USA: IEEE, 2006. https://doi.org/10.1109/DSPWS.2006.265386.

Type	Conference Paper
Author	Robert Maher
Accessed	6/7/2019, 3:34:18 PM
Date	9/2006
Publisher	IEEE
URL	http://ieeexplore.ieee.org/document/4041069/
Place	Teton National Park, WY, USA
Language	en
Conference Name	2006 IEEE 12th Digital Signal Processing Workshop & 4th IEEE Signal Processing Education Workshop
Pages	257-261
Extra	00100
Library Catalog	Crossref
ISBN	978-1-4244-0535-0
DOI	10.1109/DSPWS.2006.265386
Date Added	6/7/2019, 3:34:18 PM
Modified	6/7/2019, 3:34:19 PM

Attachments

- Maher - 2006 - Modeling and Signal Processing of Acoustic Gunshot.pdf

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Routh, Tushar Kanti. “OBSERVING VARIATION OF ACOUSTICAL CHARACTERISTICS OF SEVERAL COMMON FIREARMS IN A QUASI ANECHOIC ENVIRONMENT AT A HIGH SAMPLING RATE,” n.d., 209.

Type	Journal Article
Author	Tushar Kanti Routh
Language	en
Pages	209
Library Catalog	Zotero
Date Added	6/4/2019, 6:03:31 PM
Modified	6/4/2019, 6:03:31 PM

Attachments

- Routh - OBSERVING VARIATION OF ACOUSTICAL CHARACTERISTICS .pdf

---

Ramos, António. “On Acoustic Gunshot Localization Systems,” 558–65, 2015.

Type	Conference Paper
Author	António Ramos
Abstract	Automatic gunshot detection and localization systems have gained popularity in recent years, both for police and military use. The capabilities of such systems have been gradually improving as new techniques emerging from research laboratories are incorporated into the design. A gunshot event produces characteristic acoustic and electromagnetic signatures containing sufficient information to estimate the trajectory of the bullet and, ultimately, the shooter’s location. This paper provides an overview of acoustic based gunshot detection and localization systems. Propagation models for both the muzzle blast and the shockwave are discussed, and three specific problems related to the processing of gunshot acoustic signatures are addressed: direction-of-arrival (DOA) estimation, noise cancellation, and issues related to multipath propagation
Date	November 1, 2015
Pages	558-565
Library Catalog	ResearchGate
Date Added	12/26/2018, 6:39:12 PM
Modified	12/26/2018, 6:46:28 PM

Tags:

gunshot acoustics[2], muzzle blast, sniper localization, sonic reflection, sonic wave

Notes:

Although technical, very good intro to gunshot acoustics.

Also covers 1st thru 4th sonic wave phenomena.

Should be able to pull many relevant quotes for papers and research.

Not lay friendly, but not much is on this subject.

Attachments

- Ramos_2015_On acoustic gunshot localization systems.pdf
- ResearchGate Link

"README Acoustic Shooter Localization with a Minimal Number of Single Channel Wireless Senser Nodes.Pdf," n.d.

- Item has no authors

Berger, Theodore W. Real time acoustic event location and classification system with camera display. United States US7203132B2, filed April 7, 2006, and issued April 10, 2007. https://patents.google.com/patent/US7203132/en?oq=gunshot+audio+analysis.

Type	Patent
Inventor	Theodore W. Berger
Accessed	6/14/2018, 2:59:36 AM
URL	https://patents.google.com/patent/US7203132/en?oq=gunshot+audio+analysis
Country	US
Language	en
Assignee	Safety Dynamics Inc
Issuing Authority	United States
Filing Date	2006-04-07 2006-04-07
Application Number	US11279079
Date Added	6/14/2018, 2:59:36 AM
Modified	6/14/2018, 2:59:36 AM

Tags:

acoustic[7], data[2], gunshot[3], location, system[3]

Notes:

Classifications

G01S5/20: Position of source determined by a plurality of spaced direction-finders
G01S5/22: Position of source determined by co-ordinating a plurality of position lines defined by path-difference measurements
G01S7/003: Transmission of data between radar, sonar or lidar systems and remote stations
G01S7/52001: Auxiliary means for detecting or identifying sonar signals or the like, e.g. sonar jamming signals
Y10S367/906: Airborne shock-wave detection

README

Attachments

- Berger_2007_Real time acoustic event location and classification system with camera display.pdf

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"Route 91 Harvest Reaps Bountiful Sound With L-Acoustics - ETNow.Com." Accessed May 7, 2018. http://www.etnow.com/news/2014/11/route-91-harvest-reaps-bountiful-sound-with-l-acoustics.

Type	Web Page
Accessed	5/7/2018, 10:42:55 AM
URL	http://www.etnow.com/news/2014/11/route-91-harvest-reaps-bountiful-sound-with-l-acoustics
Date Added	5/7/2018, 10:42:55 AM
Modified	5/7/2018, 10:42:55 AM

Attachments

- Route 91 Harvest Reaps Bountiful Sound With L-Acoustics - ETNow.com

Quality report

- Item has no authors

Monongahela. “Sasquatch Bioacoustic: Using Audacity Spectrograms to Review Audio - A Cheat Sheet.” Sasquatch Bioacoustic (blog), December 23, 2011. http://sasquatchbioacoustic.blogspot.com/2011/10/using-audacity-spectrograms-to-review.html.

Type	Blog Post
Author	Monongahela
Accessed	11/23/2017, 12:59:41 PM
Date	Friday, December 23, 2011
URL	http://sasquatchbioacoustic.blogspot.com/2011/10/using-audacity-spectrograms-to-review.html
Short Title	Sasquatch Bioacoustic
Date Added	11/23/2017, 12:59:41 PM
Modified	11/23/2017, 12:59:41 PM

Attachments

- Blogspot Snapshot

Kawalec, A, J Pietrasiński, and E Danicki. “Selected Problems of Sniper Acoustic Localization,” n.d., 9.

Type	Journal Article
Author	A Kawalec
Author	J Pietrasiński
Author	E Danicki
Abstract	Acoustic signals of small arm's fire, the muzzle blast and the shock wave generated by a supersonic bullet in air, are difficult to mask and can be exploited for localization of the hidden sniper. The paper presents the system of acoustic measurements based on a number of both directional and omnidirectional microphones detecting the shock wave only, yielding exact solution for the sniper direction in spite of certain measurement errors in the directional measurements. The system has a self-correcting ability concerning the sound directional measurements which contributes to the system technical feasibility. Auxiliary muzzle blast measurements would yield the sniper position.
Language	en
Pages	9
Library Catalog	Zotero
Date Added	6/4/2019, 6:11:55 PM
Modified	6/4/2019, 6:11:55 PM

Attachments

- Kawalec et al. - Selected Problems of Sniper Acoustic Localization.pdf

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Link, Garrett F, and Nathaniel R Greene. “Sonic Range Finder Based on Gunshot Acoustics.” . . Spring, 2011, 6.

Type	Journal Article
Author	Garrett F Link
Author	Nathaniel R Greene
Abstract	A homemade sonic range finding system is arranged to measure the distance from a rifle to a target that is 35-55 meters away. With a microphone at the gun’s location and a corner reflector at the target, the abrupt sound of the gunshot itself serves as the signal whose time of flight is measured. The system’s performance is compared to that of a commercial laser range finder, which measures the time delay for an optical reflection. Both methods yield accurate results. For the homemade system, however, corrections must be made for the supersonic propagation of the bullet’s shock wave toward the target. These corrections provide insights into the acoustics of gunshots.
Publication	. Spring
Date	2011
Language	en
Pages	6
Library Catalog	Zotero
Date Added	6/4/2019, 6:25:18 PM
Modified	6/4/2019, 6:25:18 PM

Attachments

- Link and Greene - 2011 - Sonic Range Finder Based on Gunshot Acoustics.pdf

Quality report

- Publication contains a period -- is it a journal abbreviation?

Maher, Robert C. “Summary of Gun Shot Acoustics,” n.d., 7.

Type Journal Article
Author Robert C Maher
Language en
Pages 7
Library Catalog Zotero
Date Added 12/23/2018, 10:52:14 AM
Modified 12/23/2018, 10:52:14 AM

Attachments

- Maher - Summary of Gun Shot Acoustics.pdf

Contents

Lo, Kam W. “Supersonic Bullet Trajectory Estimation Using Ballistic Shock Wave Arrivals at an Acoustic Sensor Array,” 2016, 10.

Type Journal Article
Author Kam W Lo
Abstract One approach to locate the point of fire of a supersonic bullet is to first estimate the trajectory of the bullet and then trace the trajectory back to topographic or man-made obstructions on a digital map. The supersonic flight of a bullet generates a ballistic shock wave, and the trajectory of the bullet can be estimated by measuring the time delay between the shock wave arrivals at each sensor pair of an acoustic array and using an exterior ballistics model for the bullet to account for its decreasing speed with the distance travelled. In this paper, the bullet trajectory estimation problem is formulated, followed by a Cramer-Rao lower bound error analysis. A nonlinear least-squares (NLS) solution to the bullet trajectory estimation problem is then described, which assumes the ballistic constant of the bullet is known a priori. Any uncertainty in the ballistic constant will degrade the accuracy of the bullet trajectory estimation and subsequently the localization accuracy for the point of fire. The performance of the NLS method when the ballistic constant is exactly known and the degrading effect of an erroneous ballistic constant are evaluated using both simulated data and real data.
Date 2016
Language en
Pages 10
Library Catalog Zotero
Date Added 6/4/2019, 6:19:31 PM
Modified 6/4/2019, 6:19:31 PM

Attachments

- Lo - 2016 - Supersonic bullet trajectory estimation using ball.pdf

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F. Boll, Steven. “Suppression of Acoustic Noise in Speech Using Spectral Subtraction.” IEEE Trans Acoust Speech Signal Process ASSP-27 (April 1, 1979): 113–20.

Type Journal Article
Author Steven F. Boll
Abstract A stand-alone noise suppression algorithm is presented for reducing the spectral effects of acoustically added noise in speech. Effective performance of digital speech processors operating in practical environments may require suppression of noise from the digital waveform. Spectral subtraction offers a computationally efficient, processor-independent approach to effective digital speech analysis. The method, requiring about the same computation as high-speed convolution, suppresses stationary noise from speech by subtracting the spectral noise bias calculated during nonspeech activity. Secondary procedures are then applied to attenuate the residual noise left after subtraction. Since the algorithm resynthesizes a speech waveform, it can be used as a preprocessor to narrow-band voice communications systems, speech recognition systems, or speaker authentication systems.
Publication IEEE Trans Acoust Speech Signal Process
Date April 1, 1979
Volume ASSP-27
Pages 113-120
Library Catalog ResearchGate
Date Added 11/28/2017, 10:08:19 AM
Modified 11/28/2017, 10:08:19 AM

Attachments

- ResearchGate Link

Patterson, Frank K., Kevin C. Baxter, and Fred H. Holmes. System and method for identifying and locating an acoustic event. US6847587 B2, filed January 24, 2003, and issued January 25, 2005. http://www.google.com/patents/US6847587.

Type	Patent
Inventor	Frank K. Patterson
Inventor	Kevin C. Baxter
Inventor	Fred H. Holmes
Abstract	A system and method for detecting, identifying, and fixing the location of the source of an acoustic event. The inventive system includes: a plurality of sensors dispersed at somewhat regular intervals throughout a monitored area; a communication network adapted to deliver information from the sensors to a host processor; and a process within the host processor for determining, from the absolute times of arrival of an event at two or more sensors, a position of the source of the event. Acoustic events are detected and analyzed at each sensor so that the sensor transmits over the network: an identifier for the sensor; an identifier for the type of event; and a precise absolute time of arrival of the event at the sensor. In a preferred embodiment, the system also identifies the type of weapon firing a gunshot.
Accessed	12/1/2017, 10:57:42 AM
URL	http://www.google.com/patents/US6847587
Country	United States
Assignee	Frank K. Patterson,
Filing Date	2003-01-24 Jan 24, 2003
Extra	U.S. Classification 367/127, 367/906; International Classification G01S19/18, G01S7/539, F41H11/00, G01S5/30, G01V1/00, G01R31/08, H02J3/40, G01S5/00, G01S19/46, G01S19/44, G01S5/14; Cooperative Classification Y10S367/906, G01V1/001, F41H11/00, G01S7/539, G01S5/30, H02J3/40, G01S5/18, G01S19/18, G01S5/0036, G01R31/085; European Classification G01R31/08D3, G01S7/539, G01S5/18, G01S19/18, G01S5/00R1B, G01S5/30, F41H11/00, G01V1/00A, H02J3/40
Date Added	12/1/2017, 10:57:42 AM
Modified	6/6/2019, 10:31:27 AM

Tags:

acoustic[7], event[3], sensor[3], sensors[3], time[4]

Notes:

Classifications

G01S5/0036: Transmission from mobile station to base station of measured values, i.e. measurement on mobile and position calculation on base station
F41H11/00: Defence installations; Defence devices
G01R31/085: Locating faults in cables, transmission lines, or networks according to type of conductors in power transmission or distribution lines, e.g. overhead
G01S19/18: Military applications
G01S5/18: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using ultrasonic, sonic, or infrasonic waves
G01S5/30: Determining absolute distances from a plurality of spaced points of known location
G01S7/539: Details of systems according to groups G01S13/00, G01S15/00, G01S17/00 of systems according to group G01S15/00 using analysis of echo signal for target characterisation; Target signature; Target cross-section
G01V1/001: Acoustic presence detection
H02J3/40: Synchronising a generator for connection to a network or to another generator
Y10S367/906: Airborne shock-wave detection

Attachments

- Google Patents PDF
- Patterson et al_2005_System and method for identifying and locating an acoustic event.pdf

James, D J, and G Kerry. “THE PROPAGATION OF BLAST NOISE ACROSS ACOUSTICALLY HARD SURFACES,” 2000, 7.

Type	Journal Article
Author	D J James
Author	G Kerry
Abstract	In a previous paper the results of a trial to study the propagation of high energy, low frequency impulse noise across the sea were discussed. Water surfaces are generally considered as acoustically ”hard” and of significance, as far as environmental effects are concerned, is the distance over which audible, high frequency energy dissipates as the wave propagates downwind. The waveforms were compared with those obtained from trials held over grass, an acoustically ”soft” surface, where the high frequency energy was found to have dissipated over much shorter distances. It was suggested that the loss of high frequency energy is a function of the surface roughness which, in the case of the sea, is classified by the so called ”sea state” and that the high frequencies would have remained in the wave to an even greater distance if the sea had been calmer. In order to investigate the effect of surface roughness additional trials have been carried out over smooth, acoustically hard surfaces (airfield runways) and this paper presents the results of those trials.
Date	2000
Language	en
Pages	7
Library Catalog	Zotero
Date Added	6/4/2019, 10:02:15 AM

Modified 6/4/2019, 10:02:15 AM

Attachments

- James and Kerry - 2000 - THE PROPAGATION OF BLAST NOISE ACROSS ACOUSTICALLY.pdf

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"US Patent # 6,178,141. Acoustic Counter-Sniper System - Patents.Com." Accessed June 20, 2018. http://www.patents.com/us-6178141.html.

Type Web Page
Accessed 6/20/2018, 5:29:35 PM
URL http://www.patents.com/us-6178141.html
Date Added 6/20/2018, 5:29:35 PM
Modified 6/6/2019, 10:35:26 AM

Quality report

- Item has no authors

Lane Owsley, Les Atlas, and Chad Heinemann. "Use of Modulation Spectra for Representation and Classification of Acoustic Transients from Sniper Fire." In Proceedings. (ICASSP '05). IEEE International Conference on Acoustics, Speech, and Signal Processing, 2005., 4:1129–32. Philadelphia, Pennsylvania, USA: IEEE, 2005. https://doi.org/10.1109/ICASSP.2005.1416212.

Type Conference Paper
Author Lane Owsley
Author Les Atlas
Author Chad Heinemann
Abstract There are many applications for classification of acoustic transients produced by supersonic projectile fire. Analysis of existing models for such transients suggests they have properties which may be well-captured by a transform of a signal into joint acoustic and modulation frequency: a modulation spectral representation. Simple features are extracted from this representation which enables successful use in an important classification application.
Accessed 6/4/2019, 6:35:20 PM
Date 2005
Publisher IEEE
URL http://ieeexplore.ieee.org/document/1416212/
Place Philadelphia, Pennsylvania, USA
Volume 4
Language en
Conference Name (ICASSP '05). IEEE International Conference on Acoustics, Speech, and Signal Processing, 2005.
Pages 1129-1132
Library Catalog Crossref
ISBN 978-0-7803-8874-1
DOI 10.1109/ICASSP.2005.1416212
Date Added 6/4/2019, 6:35:20 PM
Modified 6/4/2019, 6:35:21 PM

Attachments

- Lane Owsley et al. - 2005 - Use of Modulation Spectra for Representation and C.pdf

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Courtney, Michael W, and Amy C Courtney. "Using Sound of Target Impact for Acoustic Reconstructions of Shooting Events." Medicine, Science and the Law 52, no. 2 (April 2012): 89–92. https://doi.org/10.1258/msl.2011.010117.

Type Journal Article
Author Michael W Courtney
Author Amy C Courtney
Abstract The sound of a bullet hitting a target is sometimes discernable in an audio recording of a shooting event and can be used to determine the distance from shooter to target. This paper provides an example where the microphone is adjacent to the shooter and presents the simple math needed in cases where the microphone is adjacent to the target. Spectrograms are also presented of the sound of bullet impact on a humansized animal.
Accessed 12/23/2018, 10:58:46 AM
Publication Medicine, Science and the Law
Date 04/2012
URL http://journals.sagepub.com/doi/10.1258/msl.2011.010117
Volume 52
Language en

Issue	2
Pages	89-92
ISSN	0025-8024, 2042-1818
Library Catalog	Crossref
DOI	10.1258/msl.2011.010117
Date Added	12/23/2018, 10:58:46 AM
Modified	12/23/2018, 10:58:46 AM

Attachments

- Courtney and Courtney - 2012 - Using sound of target impact for acoustic reconstr.pdf

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SD, Beck, Nakasone H, and Marr KW. “Variations in Recorded Acoustic Gunshot Waveforms Generated by Small Firearms.” The Journal of the Acoustical Society of America 129, no. 4 (2011): 1748–59.

Type	Journal Article
Author	Beck SD
Author	Nakasone H
Author	Marr KW
Publication	The Journal of the Acoustical Society of America
Date	2011
Volume	129
Issue	4
Pages	1748-59
ISSN	0001-4966
Date Added	10/24/2017, 10:59:27 AM
Modified	10/24/2017, 10:59:27 AM

Attachments

- Gunshot Forensics: what’s in a bang? | the.soft.anonymous

Kordis, Thomas F., and Fred McClain. Vigilante acoustic detection, location and response system. US20100226210 A1, filed December 13, 2006, and issued September 9, 2010. http://www.google.com/patents/US20100226210.

Type	Patent
Inventor	Thomas F. Kordis
Inventor	Fred McClain
Abstract	A system and method for detecting the exact location of an acoustic event, the system comprising a plurality of variably spaced sensors, wherein each sensor comprises an omnidirectional microphone for detecting the acoustic event; a global positioning system (GPS); and a transmitter receiver for transmitting (i) the time that the acoustic event arrived at a particular sensor and (ii) the location of the particular sensor at the time the acoustic event arrived at the particular sensor; and a central processor radio-linked to the plurality of variably spaced sensors comprising a software program comprising at least one algorithm for determining the location of the acoustic event.
Accessed	12/1/2017, 10:59:23 AM
URL	http://www.google.com/patents/US20100226210
Country	United States
Assignee	Kordis Thomas F,
Filing Date	2006-12-13 Dec 13, 2006
Extra	U.S. Classification 367/127; International Classification G01S3/80; Cooperative Classification G01S5/0027, G01S5/22, G01S5/0221, G01S5/0036, G01S5/0252; European Classification G01S5/00R1A, G01S5/00R1B, G01S5/22, G01S5/02A3, G01S5/02D
Date Added	12/1/2017, 10:59:23 AM
Modified	6/6/2019, 10:28:28 AM

Tags:

acoustic[7], event[3], sensor[3], sensors[3], system[3]

Notes:

Classifications

G01S5/0036: Transmission from mobile station to base station of measured values, i.e. measurement on mobile and position calculation on base station
G01S5/0027: Transmission from mobile station to base station of actual mobile position, i.e. position determined on mobile
G01S5/0221: Details of receivers or network of receivers
G01S5/0252: Position-fixing by co-ordinating two or more direction or position line determinations; Position-fixing by co-ordinating two or more distance determinations using radio waves by comparing measured values with pre-stored measured or simulated values
G01S5/22: Position of source determined by co-ordinating a plurality of position lines defined by path-difference measurements

Attachments

- Google Patents PDF
- Kordis_McClain_2010_Vigilante acoustic detection, location and response system.pdf

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Khan, Saad, Ajay Divakaran, and Harpreet Singh Sawhney. Weapon identification using acoustic signatures across varying capture conditions. United States US8385154B2, filed April 23, 2010, and issued February 26, 2013. https://patents.google.com/patent/US8385154/en?oq=gunshot+audio+analysis.

Type	Patent
Inventor	Saad Khan
Inventor	Ajay Divakaran
Inventor	Harpreet Singh Sawhney
Accessed	6/14/2018, 2:07:28 AM
URL	https://patents.google.com/patent/US8385154/en?oq=gunshot+audio+analysis
Country	US
Language	en
Assignee	SRI International
Issuing Authority	United States
Filing Date	2010-04-23 2010-04-23
Application Number	US12766219
Date Added	6/14/2018, 2:07:28 AM
Modified	6/14/2018, 2:07:28 AM

Tags:

acoustic[7], exemplar[2], exemplars[2], gunshot[3], set[2]

Notes:

<h2>Classifications</h2>
G10L25/48: Speech or voice analysis techniques not restricted to a single one of groups G10L15/00-G10L21/00 specially adapted for particular use

Attachments

- Khan et al_2013_Weapon identification using acoustic signatures across varying capture.pdf

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Khan, Saad, Ajay Divakaran, and Harpreet Singh Sawhney. Weapon identification using acoustic signatures across varying capture conditions. United States US20100271905A1, filed April 23, 2010, and issued October 28, 2010. https://patents.google.com/patent/US20100271905A1/en?oq=7%2c359%2c285.

Type	Patent
Inventor	Saad Khan
Inventor	Ajay Divakaran
Inventor	Harpreet Singh Sawhney
Accessed	6/14/2018, 3:56:47 AM
URL	https://patents.google.com/patent/US20100271905A1/en?oq=7%2c359%2c285
Country	US
Language	en
Assignee	Saad Khan, Ajay Divakaran, Harpreet Singh Sawhney
Issuing Authority	United States
Filing Date	2010-04-23 2010-04-23
Application Number	US12766219
Date Added	6/14/2018, 3:56:48 AM
Modified	6/14/2018, 3:56:48 AM

Tags:

acoustic[7], exemplar[2], exemplars[2], set[2], signature

Notes:

<h2>Classifications</h2>
G10L25/48: Speech or voice analysis techniques not restricted to a single one of groups G10L15/00-G10L21/00 specially adapted for particular use

Attachments

- Khan et al_2010_Weapon identification using acoustic signatures across varying capture.pdf