

CURRICULUM VITAE

Jack H. Noble
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Dept. of Electrical & Computer Engineering
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ACADEMIC EXPERIENCE

2021-Present Assistant Professor of Electrical & Computer Engineering
2021-Present Secondary Appointment in Dept. of Computer Science
2018-2021 Assistant Professor of Electrical Engineering, Computer Engineering, and Computer Science
2018-Present Secondary Appointment in Dept. of Biomedical Engineering
2015-Present Secondary Appointment in Dept. of Hearing and Speech Sciences
2014-Present Secondary Appointment in Dept. of Otolaryngology – Head & Neck Surgery
2011-2017 Research Assistant Professor, Dept. of Elect. Engineering & Computer Science
2006-2011 Research Assistant in the Medical Image Processing Laboratory at Vanderbilt University

EDUCATION

2011 Ph.D. in Electrical Engineering, Vanderbilt University
Dissertation: *Automatic Identification of the Structures of the Ear and a New Approach for Tubular Structure Modeling and Segmentation*
2008 M.S. in Electrical Engineering, Vanderbilt University
Thesis: *Automatic determination of optimal surgical drilling trajectories for cochlear implant surgery*
2007 B.E. in Electrical Engineering, Vanderbilt University
Honors Thesis: *Automatic segmentation of the facial nerve for use in pre-operative planning of cochlear implant surgery*

HONORS AND AWARDS

Individual

2016 Communication Services Award from the Dept. of Hearing and Speech Sciences at the Vanderbilt Bill Wilkerson Center
2015-2017 Awarded NIH Clinical Research Loan Repayment Program Grant (L30)
2013 Awarded \$1000 first place prize for best poster at the Vanderbilt Bill Wilkerson Center for Otolaryngology and Communication Sciences Combined Poster Session
2012-2014 Awarded NIH Clinical Research Loan Repayment Program Grant, L30DC012689
2010 Top ten finalist in the best student paper competition at the SPIE Conference on Medical Imaging
2008-2011 NIH/NIDCD Pre-doctoral Fellowship
2007-2011 Awarded IBM Engineering Graduate Scholarship
2007 Magna Cum Laude with Honors, Vanderbilt University
2006 Awarded stipend from the Vanderbilt Undergraduate Summer Research Program to conduct the research project “Automatic identification of the facial nerve in CT for percutaneous cochlear implant surgery”

Student Awards (mentor)

2022 Awarded \$100 2nd place prize for best poster at the Vanderbilt Annual Electrical & Computer Engineering Day Poster Session (Erin Bratu)

2022	Awarded Vanderbilt University School of Engineering Summer Undergraduate Research Fellowship (Rui Wang)
2021	Awarded Vanderbilt Institute for Surgery and Engineering Summer Undergraduate Research Fellowship (Yiqi Zhao)
2018	Awarded Vanderbilt University Summer Research Project Fellowship (Jeffrey Zhang)
2018	Awarded Vanderbilt Institute for Surgery and Engineering Summer Undergraduate Research Fellowship (Ghassan Alduraibi)
2018	Awarded Vanderbilt University School of Engineering Summer Undergraduate Research Fellowship (Minh Vu)
2018	Runner up for the Siemens Young Scientist Award at the 2018 SPIE Medical Imaging Conference on Image-guided procedures, robotic interventions, and modeling (Yiyuan Zhao)
2017	Runner up in the best student paper competition at the SPIE Conference on Medical Imaging 2017 (Ahmet Cakir)
2014-2015	Awarded Vanderbilt Institute in Surgery and Engineering (VISE) Fellowship (Yiyuan Zhao)
2013	Awarded Vanderbilt University School of Engineering Summer Undergraduate Research Program Fellowship (Rebecca Turok)
2012	Top ten finalist in the best student paper competition at the SPIE Conference on Medical Imaging 2012 (Fitsum Reda)

PROFESSIONAL MEMBERSHIPS

2008-Present	Member, Institute of Electrical and Electronic Engineers (IEEE)
2008-Present	Member, Medical Image Computing and Computer Assisted Intervention Society (MICCAI)
2008-Present	Member, International Society for Optics and Photonics (SPIE)

RESEARCH FUNDING

Principal Investigator (Total award: \$5,637,791)

Model-based cochlear implant programming techniques Jun. 2020 – Apr. 2025
 R01DC014037 Total award amount (Direct + Indirect): \$3,127,549 Funding Agency: NIH/NIDCD
 The goals of this project are to develop and evaluate new patient-customized models of cochlear implant stimulation that could provide objective information to the programming process and lead to programs that better approximate natural hearing performance.

I-Corps: Analyzing the cochlear implant programming market and assessing the need for image guided cochlear implant programming Jan 2019 – Dec 2019
 1912657 Total award amount (Direct + Indirect): \$40,000 Funding Agency: NSF
 The goal of this project is to perform customer discovery for image guided cochlear implant programming technology.

Image-guided cochlear implant programming techniques Jun. 2014-May 2020
 R01DC014037 Total award amount (Direct + Indirect): \$1,888,851 Funding Agency: NIH/NIDCD
 The goals of this project are to develop and evaluate new patient-customized, Image-Guided Cochlear Implant Programming (IGCIP) strategies that could provide objective information to the programming process and lead to programs that better approximate natural hearing performance.

Image-based frequency reallocation for optimizing cochlear implant programming Jul. 2012-Jun. 2015
 R21DC012620 Total award amount (Direct + Indirect): \$419,075 Funding Agency: NIH/NIDCD
 Recent advances in image processing have permitted accurate detection of the post-operative position of cochlear implant electrodes relative to stimulation targets. This project aims to use this technology to develop and test the first electrode position-dependent cochlear implant programming schemes. Electrode position-dependent programming approaches have the potential to drastically improve hearing performance for implant users.

Accurate Localization of General Tubular Structures in Medical Images Jun. 2008-May 2011

F31DC009791 Total award amount (Direct + Indirect): \$162,316 Funding Agency: NIH/NIDCD
 To propose, develop, and validate a new approach for tubular structure modeling and segmentation using graph-based techniques.

Co-Investigator

Predicting speech recognition in adults receiving cochlear implants Aug 2021 – May 2026
 R01DC019088 Total award amount: \$2,655,130 Funding Agency: NIH/NIDCD
 PI: Prof. Aaron Moberly, M.D.
 This project will determine how a comprehensive approach including “bottom-up” sensory and “top-down” cognitive-linguistic factors predicts CI outcomes after implantation.

Algorithm Development for Ultrasonic Sensing System for Naval Mine Detection June 2020 – June 2023
 N00174-20-1-0013 Total award amount: \$404,944 Funding Agency: DoD
 PI: Prof. Jason Mitchell, Ph.D.
 The objective of this project is to develop systems and image processing algorithms to facilitate ultrasonic sensing systems for deep and turbid water visualization applications for the U.S. Navy.

Image-Guided Cochlear Implant Programming: Pediatric Speech, Language, and Literacy Apr. 2019 – Mar. 2024
 1R01DC017683 Total award amount: \$2,313,765 Funding Agency: NIH/NIDCD
 PI: Prof. René H. Gifford, Ph.D.
 Vanderbilt site-PI: Jack Noble
 The objective of this project is to examine the impact of a personalized, image-guided approach to CI programming and its effect on auditory processing, speech recognition, speech production, phonological processing, language, and literacy.

Peripheral and central contributions to auditory temporal processing deficits and speech understanding in older cochlear implantees Apr. 2022 – Mar. 2027
 R01DC020316 Total award amount: \$60,627 Funding Agency: NIH/NIDCD
 PI: Prof. Matthew Goupell, Ph.D.
 Vanderbilt site PI: Jack Noble
 The long-term goals of this grant are to (1) understand the biological effects of auditory aging and (2) determine how to best remediate age-related auditory deficits with a CI.

Clinical Validation and Testing of Percutaneous Cochlear Implantation Jul. 2012-Mar. 2023
 R01DC008408 Total award amount (Direct + Indirect): \$2,935,640 Funding Agency: NIH/NIDCD
 PI: Prof. Robert F. Labadie, M.D., Ph.D.
 Using image guided surgical techniques—similar to GPS technology used to provide geographic directions—we have shown that a much less invasive surgical approach to cochlear implantation is possible by tracking and controlling the path of a drill such that the cochlea may be reached by a single drill pass—we call this technique Percutaneous Cochlear Implantation (PCI). In this project, we will compare PCI to traditional CI surgery via a randomized clinical trial looking at time of surgery and injury of surrounding tissue.

Quantitative Image Analysis Techniques for Optic Nerve Disease Dec. 2013-Nov. 2015
 R21EY024036 Total award amount (Direct + Indirect): \$414,016 Funding Agency: NIH/NEI
 PI: Prof. Bennett A. Landman, Ph.D.
 To translate medical imaging computing procedures from the neuroimaging community to provide robust, quantitative tools for assessing the optic nerve (ON) on clinical and research imaging sequences.

Computer-assisted, image-guided programming of Cochlear Implants

R01DC014462 Total award amount: \$3,857,205

Dec. 2015-Nov. 2020

Funding Agency: NIH/NIDCD

PI: Prof. Benoit M. Dawant, Ph.D.

To mature the system we have developed for patient-customized, image-guided cochlear implant programming to produce a system that will be clinically deployable, thus increasing the number of cochlear implant recipients who can benefit from this technology.

Optimizing Bilateral and Single-Sided Deafness Cochlear Implants for Functioning in Complex Auditory Environments

R01DC15798 Total award amount: \$15,681

July 2017-Nov. 2020

Funding Agency: NIH/NIDCD

PI: Joshua Bernstein, Ph.D., Walter Reed National Military Medical Center

Vanderbilt site-PI: Jack Noble

To investigate the deleterious effect of frequency place mismatch on hearing outcomes with cochlear implants and develop and test approaches to improve outcomes by reducing frequency mismatch.

Transnasal Diagnosis of Middle Ear Disease

R21DC16153 Total award amount: \$446,414

Sept. 2017-Aug. 2019

Funding Agency: NIH/NIDCD

PI: Prof. Robert Webster, Ph.D.

The objective of this proposal is to replace exploratory surgery with a novel natural-orifice approach to diagnose and surveil middle ear disease.

GRANT REVIEWING

- 2018 Served on the NIH/NIDCD Translational R01 review ZDC1 SRB-R 34 study section.
- 2017 Served on the NIH/NIDCD Hearing and Balance Fellowships Review ZDC1 SRB-X 66 study section.
- 2016 Served on the NIH/NIDCD Translational R01 review ZDC1 SRB-X63 study section.
- 2016 Served as reviewer for Action on Hearing Loss research grant program.

JOURNAL EDITORIAL BOARD SERVICE & REVIEWING*Editorial Board*

- 2021-Present Editorial board member for *BMC Medical Imaging*
- 2020 Associate Editor for *SPIE Journal of Medical Imaging* Special Issue on Interventional and Surgical Data Science
- 2017 Associate Editor for *SPIE Journal of Medical Imaging* Special Issue on Image-Guided Procedures, Robotic Interventions, and Modeling

Reviewer

- Annals of Biomedical Engineering
- Audiology & Neurotology
- Int'l. J. of Computer Aided Radiology and Surgery
- Ear and Hearing
- European Archives of Oto-Rhino-Laryngology
- I.E.E.E. Access
- I.E.E.E. Transactions on Biomedical Engineering
- I.E.E.E. Transactions on Medical Imaging
- Medical Engineering & Physics
- Medical Image Analysis
- Medical Physics
- J. of Medical Imaging
- Int'l. J. of Medical Robotics and Computer Assisted Surgery

Nature: Scientific Reports
Otology & Neurotology
Physics in Medicine and Biology
Trends in Hearing

CONFERENCE PROGRAM COMMITTEES & REVIEWING

Program Committee for the Int'l Conference on Medical Imaging with Deep Learning (MIDL) '23
Program Committee for Int'l Conference on Medical Image Computing and Computer Assisted Interventions (MICCAI) '20
Program Committee Member for 7th Annual Surgery, Intervention, and Engineering Symposium at the Vanderbilt Institute for Surgery and Engineering (2018)
Program Committee Member for SPIE: Medical Imaging Conf. on Image-Guided Procedures, Robotic Interventions, and Modeling (2017-Present)
Program Committee Member for Workshop on Simulation and Synthesis in Medical Imaging – '18, '19, '20, '21, '22
Program Committee Member for Workshop on Biomedical Image Registration (WBIR 2012)
Reviewer for Int'l Conference on Medical Image Computing and Computer Assisted Interventions (MICCAI) '10, '11, '12, '13, '14, '15, '16, '18, '21
Reviewer for IEEE International Conference on Biomedical Robotics and Biomechanics
Reviewer for 12th workshop on Augmented Environments for Computer-Assisted Interventions

PATENTS

- [1]. Jack H. Noble, Robert F. Labadie, Benoit M. Dawant, "Patient-Customized Electrode Arrays Based on Patient-Specific Cochlear Information, and Designing/Selecting Methods and Applications of Same," U.S. patent 11,027,129, 2021.
- [2]. Erin L. Bratu, René Gifford, Robert Labadie, Benoit Dawant, Jack, "A Graph-Based Method for Optimal Active Electrode Selection in Cochlear Implants," U.S. provisional application no. 63/246,501, 2021
- [3]. Yubo Fan, Rueben Banalagay, Jack H. Noble, Benoit M. Dawant, "Automatic Segmentation of Intracochlear Anatomy in MR Images Using a Weighted Active Shape Model," U.S. provisional application no. 63/249,125, 2021
- [4]. Jianing Wang, Jack H. Noble, Robert F. Labadie, Benoit M. Dawant, "Automatic Segmentation of Intracochlear Anatomy in Metal Artifact Affected CT Images of the Ear with Deep Neural Networks," US Patent App. 17/266,180, 2022
- [5]. Jack H. Noble, Ahmet Cakir, Benoit M. Dawant, Robert F. Labadie, Rene H. Gifford, "Patient Customized Electro-Neural Interface Models for Model-Based Cochlear Implant Programming and Applications of Same," U.S. patent application 17/637,875, 2022
- [6]. Benoit M. Dawant, Jianing Wang, Jack H. Noble, Robert F. Labadie, "Deep-Learning-Based Method for Metal Reduction in CT Images," U.S. provisional patent application PCT/US19/45221, 2019
- [7]. Jack H. Noble, Robert F. Labadie, Benoit M. Dawant, "Methods and Systems for Optimizing Selection and Placement of Cochlear Implant Electrode Arrays using Patient-Specific Cochlear Information and Applications of the Same," U.S. patent 11,406,826, 2022
- [8]. Jack H. Noble, Benoit M. Dawant, Robert F. Labadie, René H. Gifford, "Current Steering Compatible Image-Guided Cochlear Implant Electrode Deactivation Methods and Application of Same," U.S. patent 10,821,284, 2020
- [9]. Fitsum A. Reda, Jack H. Noble, Robert F. Labadie, Benoit M. Dawant, "An artifact-robust, shape library-based algorithm for automatic segmentation of inner ear anatomy in post-cochlear-implantation CT," U.S. patent pending, 2014
- [10]. Fitsum A. Reda, Jack H. Noble, Benoit M. Dawant, Robert F. Labadie, "Method for Automatic Segmentation of Intra-Cochlear Anatomy in Post-Unilateral-Implantation CT," U.S. Patent pending, 2013
- [11]. Jack H. Noble, René H. Gifford, Robert F. Labadie, and Benoit M. Dawant, "Methods and systems for customizing cochlear implant stimulation and applications of same," US Patent 10,546,388, 2020.

- [12]. Jack H. Noble and Benoit M. Dawant, "Method for Automatic Segmentation of the Facial Nerve and Chorda Tympani in CT Images," U.S. patent no. 8,073,216, 2011

LICENSED SOFTWARE

- 2009-2014 *Ear Navigator*, software that performs automatic identification of ear anatomy in adult CT's and visualizes the results in a GUI with 3D and 2D rendering environments. Licensed to Ototronix, LLC.
- 2012-2013 *Cochlear Implant Planner*, software to visualize the location of cochlear implant electrode arrays in CT images in a GUI with 3D and 2D rendering environments. Licensed to Cochlear LTD.

PEER-REVIEWED PUBLICATIONS (H-INDEX: 39, CITATIONS: 4866)

Archival Journal Publications

- [1]. MR Smetak, SJ Fernando, MR O'Malley, ML Bennett, DS Haynes, CT Wootten, FW Virgin, RT Dwyer, BM Dawant, JH Noble, RF Labadie, "Electrode Array Positioning after Cochlear Reimplantation from Single Manufacturer," *Cochlear Implants International*, 2023 (in press)
- [2]. MR Smetak, KE Riojas, N Whittenbarger, JH Noble, RF Labadie, "Dynamic Behavior and Insertional Forces of a Precurved Electrode Using the Pull-Back Technique in a Fresh Microdissected Cochlea," *Otology & Neurotology*, 2023 (in press)
- [3]. EL Bratu, LW Sunderhaus, KA Berg, RT Dwyer, RF Labadie, RH Gifford, JH Noble, "Activation region overlap visualization for image-guided cochlear implant programming," *Biomedical Physics & Engineering Express* 9 (1), 015001, 2022
- [4]. M Cleary, JGW Bernstein, OA Stakhovskaya, J Noble, E Kolberg, "The Relationship Between Interaural Insertion-Depth Differences, Scalar Location, and Interaural Time-Difference Processing in Adult Bilateral Cochlear-Implant Listeners," *Trends in Hearing* vol. 26, 1-24, 2022.
- [5]. CC Munhall, JH Noble, B Dawant, RF Labadie, "Cochlear Implant Translocation: Diagnosis, Prevention, and Clinical Implications," *Current Otorhinolaryngology Reports*, vol. 10, 337-342, 2022.
- [6]. RH Gifford, LW Sunderhaus, JT Holder, KA Berg, BM Dawant, JH Noble, "Speech recognition as a function of the number of channels for pediatric cochlear implant recipients," *JASA Express Letters* 2 (9), 094403, 2022.
- [7]. RH Gifford, LW Sunderhaus, BM Dawant, RF Labadie, JH Noble, "Cochlear implant spectral bandwidth for optimizing electric and acoustic stimulation (EAS)," *Hearing Research*, vol. 426, 108584, 2022.
- [8]. KA Berg, JH Noble, BM Dawant, RT Dwyer, RF Labadie, RH Gifford, "Speech recognition as a function of the number of channels for Mid-Scala electrode array recipients," *The Journal of the Acoustical Society of America* 152 (1), 67-79, 2022.
- [9]. EL Perkins, RF Labadie, M O'Malley, M Bennett, JH Noble, DS Haynes, "The relation of cochlear implant electrode array type and position on continued hearing preservation," *Otology & Neurotology* vol. 43 (6), e634-e640, 2022
- [10]. MF Dorman, SC Natale, JH Noble, DM Zeitler, "Upward shifts in the internal representation of frequency can persist over a 3-year period for cochlear implant patients fit with a relatively short electrode array," *Frontiers in Human Neuroscience* vol 16; 863891, 2022.
- [11]. MH Freeman, JB Gafford, L Fichera, J Noble, RJ Webster III, RF Labadie, "Transeustachian Middle Ear Endoscopy Using a Steerable Distal-Camera Tipped Endoscope," *Otology & Neurotology* 43 (2), 206-211, 2022.
- [12]. Yubo Fan, Dongqing Zhang, Rueben Banalagay, Jianing Wang, Jack H. Noble, Benoit M. Dawant, "Hybrid active shape and deep learning method for the accurate and robust segmentation of the intracochlear anatomy in clinical head CT and CBCT images," *Journ. Of Medical Imaging*, vol. 8 (6), 064002, 2021
- [13]. Joshua G. W. Bernstein, Kenneth K. Jensen, Olga A. Stakhovskaya, Jack H. Noble, Michael Hoa, H. Jeffery Kim, Robert Shih, Elizabeth Kolberg, Miranda Cleary, and Matthew Goupell, "Interaural Place-of-Stimulation Mismatch Estimates Using CT Scans and Binaural Perception, But Not Pitch, Are Consistent in Cochlear-Implant Users," *The Journal of Neuroscience*, vol. 41(49), 10151-10178, 2021.
- [14]. Matthew J. Goupell, Jack H. Noble, Sandeep A. Phatak, Elizabeth Kolberg, Miranda Cleary, Olga A. Stakhovskaya, Kenneth K. Jensen, Michael Hoa, H. Jeffery Kim, and Joshua G. W. Bernstein, "Computed-tomography estimates of interaural mismatch in insertion depth and scalar location in bilateral cochlear-implant users," *Otology & Neurotology* 43 (6), 666-675
- [15]. Katelyn A. Berg, Jack H. Noble, Benoit M. Dawant, Robert T. Dwyer, Robert F. Labadie, René H. Gifford, "Speech recognition as a function of the number of channels for an array with large inter-electrode distances," *Journal of the Acoustic Society of America* vol. 149 (2752), 2021.
- [16]. KE Riojas, ET Tran, MH Freeman, JH Noble, RJ Webster, RF Labadie, "Clinical Translation of an Insertion Tool for Minimally Invasive Cochlear Implant Surgery," *Jour. of Medical Devices* vol. 15 (3), 031001, 2021
- [17]. William G Morrel, Nauman F Manzoor, Benoit M Dawant, Jack H Noble, Robert F Labadie, "Intraoperative Correction of Cochlear Implant Electrode Translocation," *Audiology & neurotology* vol. 27(1), pp. 18-22, 2021

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- [18]. Labadie, Robert F.; Riojas, Katherine; Von Wahlde, Kathleen; Mitchell, Jason; Bruns, Trevor; Webster, Robert III; Dawant, Benoit; Fitzpatrick, J. Michael; Noble, Jack; "Clinical Implementation of Second-generation Minimally Invasive Image-guided Cochlear Implantation Surgery," *Otology & Neurotology* 2021 Jun 1;42(5):702-705
- [19]. J Gafford, M Freeman, L Fichera, J Noble, R Labadie, RJ Webster III, "Eyes in Ears: A Miniature Steerable Digital Endoscope for Trans-Nasal Diagnosis of Middle Ear Disease," *Ann Biomed Eng*, 49(1):219-232, 2021.
- [20]. René Gifford, Stephen Camarata, Robert Labadie, Benoit Dawant, Linsey Sunderhaus, Emily Byram, Jack Noble, "Image-guided Cochlear Implant Programming for Pediatric CI Recipients," *The Hearing Journal* vol. 73(12), pp. 38-9, 2020.
- [21]. Rueben A Banalagay, Robert F Labadie, Jack H Noble, "Insertion Depth for Optimized Positioning of Pre-Curved Cochlear Implant Electrodes," *Otology & Neurotology*, vol. 41(8), pp. 1066-71, 2020.
- [22]. Mohammad M. R. Khan, Robert F. Labadie, Jack H. Noble, "Preoperative prediction of angular insertion depth of lateral wall cochlear implant electrode arrays," *Journal of Medical Imaging*, vol. 7 (3), pp. 031504, 2020.
- [23]. KA Berg, JH Noble, BM Dawant, RT Dwyer, RF Labadie, RH Gifford, "Speech recognition with cochlear implants as a function of the number of channels: Effects of electrode placement," *Journal of the Acoustical Society of America*, vol. 147 (5), pp. 3646-3656, 2020.
- [24]. WG Morrel, KE Riojas, RJ Webster III, JH Noble, RF Labadie, "Custom mastoid-fitting templates to improve cochlear implant electrode insertion trajectory," *International journal of computer assisted radiology and surgery*, vol. 15, pp. 1713-1718, 2020.
- [25]. Dorman, Michael; Natale, Sarah; Baxter, Leslie; Zeitler, Daniel; Carlson, Matthew; Lorens, Artur; Skarzynsky, Henryk; Peters, Jeroen; Noble, Jack, "Approximations to the voice of a cochlear implant: Explorations with single-sided deaf listeners fit with MED EL implants," *Trends in Hearing*, vol. 24, 2020.
- [26]. Dongqing Zhang, Jianing Wang, Jack Noble, Benoit Dawant, "HeadLocNet: Deep Convolutional Neural Networks for Accurate Classification and Multi-landmark Localization of Head CTs Medical Image Analysis," *Medical Image Analysis*, vol. 61, pp. 101659, 2020.
- [27]. François-Xavier Carton, Matthieu Chabanas, Florian Le Lann, Jack H. Noble "Automatic segmentation of brain tumor resections in intraoperative ultrasound images," *Journal of Medical Imaging*, vol. 7(3), pp. 031503, 2020.
- [28]. Will Morrel, Jourdan Holder, Benoit Dawant, Jack Noble, Robert Labadie, "Effect of Scala Tympani Height on Insertion Depth of Straight Cochlear Implant Electrodes," *Otolaryngology – Head and Neck Surgery*, vol. 162 (4), pp. 718-24, 2020.
- [29]. Robert Labadie, Antonio Schefano, Jourdan Holder, Robert Dwyer, Alejandro Rivas, Matthew O'Malley, Jack Noble, Benoit Dawant, "Use of intraoperative CT scanning for quality control assessment of cochlear implant electrode array placement," *Acta Oto-Laryngologica*, 140(3):206-211, 2020
- [30]. Jianing Wang, Jack Noble, Benoit Dawant, "Metal Artifact Reduction for the Segmentation of the Intra Cochlear Anatomy in CT Images of the Ear with 3D Conditional GANs," *Medical Image Analysis*, vol. 58 (101553), 2019.
- [31]. Riggs WJ, Dwyer RT, Holder JT, Mattingly JK, Ortmann A, Noble JH, Dawant BM, Valenzuela CV, O'Connell BP, Harris MS, Litvak LM, Koka K, Buchman CA, Labadie RF, Adunka OF, "Intracochlear Electrocochleography: Influence of Scalar Position of the Cochlear Implant Electrode on Postinsertion Results," *Otology & Neurotology*, vol. 40(5), 2019.
- [32]. Michael F. Dorman , Sarah C. Natale , Daniel M. Zeitler , Leslie Baxter, and Jack H. Noble, "Looking for Mickey Mouse™ But Finding a Munchkin: The Perceptual Effects of Frequency Upshifts for Single-Sided Deaf, Cochlear Implant Patients," *Journal of Speech, Language, and Hearing Research*, vol. 62(9), pp. 1-7, 2019.
- [33]. Y Zhao, S Chakravorti, RF Labadie, BM Dawant, JH Noble, "Automatic graph-based method for localization of cochlear implant electrode arrays in clinical CT with sub-voxel accuracy," *Medical image analysis*, vol. 52, pp. 1-12, 2019.
- [34]. Katelyn Berg, Jack Noble, Benoit Dawant, Robert Dwyer, Robert Labadie, Rene Gifford, "Speech recognition as a function of the number of channels in perimodiolar electrode recipients," *Journal of the Acoustical Society of America*, vol. 145, pp. 1556-64, 2019.
- [35]. Srijata Chakravorti and Jack H. Noble (co-first authors), René H. Gifford, Benoit M. Dawant, Brendan O'Connell, Jianing Wang, Robert F. Labadie, "Further evidence of the relationship between cochlear implant electrode positioning and hearing outcomes," *Otology & Neurotology*, vol. 40 (5), pp. 617-624, 2019.
- [36]. William G Morrel, Asitha DL Jayawardena, Susan M. Amberg, Benoit M Dawant, Jack H Noble, Robert F Labadie, "Revision surgery following minimally invasive image-guided cochlear implantation", *Laryngoscope*, vol. 129(6), pp. 1458-1461, 2019.
- [37]. KA Berg, JH Noble, B Dawant, R Dwyer, R Labadie, RH Gifford, "Effect of number of channels and speech coding strategy on speech recognition in mid-scala electrode recipients," *Journal of the Acoustical Society of America* vol. 145 (3), pp. 1796-1797, 2019.
- [38]. MF Dorman, SC Natale, L Baxter, DM Zeitler, ML Carlson, JH Noble, "Cochlear Place of Stimulation Is One Determinant of Cochlear Implant Sound Quality," *Audiology and Neurotology* 24 (5), 264-269, 2019.
- [39]. KA Berg, J Noble, B Dawant, R Dwyer, R Labadie, V Richards, R Gifford, "Musical sound quality as a function of the number of channels in modern cochlear implant recipients," *Frontiers in neuroscience* 13, 999, 2019
- [40]. BP O'Connell, MT Dillon, JH Noble, GB Wanna, ER King, HC Pillsbury, KB Brown, "Insertion depth impacts speech perception and hearing preservation outcomes for lateral wall electrodes," *Journal of Hearing Science*, Vol. 8(2), 2018.
- [41]. Kanthaiiah Koka, William Jason Riggs, Robert Dwyer, Jourdan Taylor Holder, Jack H Noble, Benoit M Dawant, Amanda Ortmann, Carla V Valenzuela, Jameson K Mattingly, Michael M Harris, Brendan P O'Connell, Leonid M Litvak, Oliver F Adunka, Craig Alan Buchman, Robert F Labadie, "Intra-Cochlear Electrocochleography During Cochlear Implant Electrode Insertion Is Predictive of Final Scalar Location," *Otology & Neurotology* vol. 39(8) pp. e654-e659, 2018.
- [42]. Yiyuan Zhao, Robert Labadie, Benoit Dawant, Jack Noble, "Validation of cochlear implant electrode localization techniques using μ CTs," *Journal of Medical Imaging*, vol. 5(3), pp. 035001, 2018.

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- [43]. Rene H Gifford, Jack H Noble, Stephen M Camarata, Linsey W Sunderhaus, Robert T Dwyer, Benoit M Dawant, Mary S Dietrich, Robert F Labadie, "The relationship between spectral modulation detection and speech recognition: Adult versus pediatric cochlear implant recipients," *Trends in Hearing*, vol. 22, 2018.
- [44]. Yiyuan Zhao, Benoit Dawant, and Jack Noble., "Automatic localization of closely-spaced cochlear implant electrode arrays in clinical CTs," *Med. Phys.*, vol 45 (11), pp. 5030-5040, 2018.
- [45]. Holder JT, Kessler DM, Noble JH, Gifford RH, Labadie RF, "Prevalence of Extracochlear Electrodes: Computerized Tomography Scans, Cochlear Implant Maps, and Operative Reports," *Otology & Neurotology*, vol. 39(5), e325-e331, 2018.
- [46]. Jack Noble and Robert Labadie, "Preliminary results with image-guided cochlear implant insertion techniques," *Otology & Neurotology*, vol. 39(7), pp. 922-928, 2018.
- [47]. Dongqing Zhang, Yiyuan Zhao, Jack H. Noble, Benoit M. Dawant, "Selecting electrode configurations for image-guided cochlear implant programming using template matching.," *Journal of Medical Imaging*, vol. 5(2), pp. 021202, 2018.
- [48]. Gabriela Pereira Bom Braga, Jack H Noble, Eloisa Maria Mello Santiago Gebrim, Robert F Labadie, Ricardo Ferreira Bento, "The influence of the subarcuate artery in the superior semicircular canal dehiscence and its frequency on stillbirths: illustrative cases and systematic review," *Acta oto-laryngologica*, 2017.
- [49]. Gabriela Pereira Bom Braga, Eloisa Gebrim, Ramya Balachandran, Jack Noble, Robert Labadie, Ricardo Ferreira Bento, "Evaluation of the Facial Recess and Cochlea on the Temporal Bone of Stillbirths regarding the Percutaneous Cochlear Implant," *International Archives of Otorhinolaryngology*, s-0037-1606612, 2017.
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Peer-Reviewed Conference Proceedings

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INVITED TALKS

- [1]. Jack Noble, "Computer-Assistance Techniques for Cochlear Implant Interventions," Invited talk at Ohio State University dept of Otolaryngology, 2019.
- [2]. Jack Noble, "Computer-Assistance Techniques for Cochlear Implant Interventions," Invited WithIT Seminar, Vanderbilt University dept of Computer Science, 2019.
- [3]. Jack Noble, "Computer-Assistance Techniques for Cochlear Implant Interventions," Invited talk presented at Walter Reed National Military Medical Center, 2017.
- [4]. Jack Noble, "Computer-Assistance Techniques for Cochlear Implant Interventions," Invited talk presented at University of Maryland, 2017.
- [5]. Jack Noble, Robert Labadie, Rene Gifford, "Use of imaging to improve cochlear implantation and clinical management," Invited talk presented at Otolaryngology group at Medical University South Carolina, 2016.
- [6]. Jack Noble, Robert Labadie, Benoit Dawant, Rene Gifford, "Wired for Sound – Treating Deafness with Cochlear Implants" Invited talk presented at the 2016 Creative Minds series hosted by the U.S. Ambassador to Ireland at Deerfield Park in Dublin, Ireland.
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- [8]. Noble J.H., Labadie R.F., Dawant B.M., Hedley-Williams A., Sunderhaus L., Camarata S., Gifford R., "Image-guided cochlear implant programming in children," Invited talk presented at the 14th Symposium on Cochlear Implants in Children, 2014.
- [9]. Noble J.H., "Image analysis-based guidance and decision support for cochlear implant interventions," Invited talk presented at the 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2014.
- [10]. Noble J.H., "Development of computer assistance techniques for otological intervention," Invited talk presented to Vanderbilt Dept. of Biomedical Engineering, 2013.

CONFERENCE ABSTRACTS & PROCEEDINGS

- [1]. Hannah G. Mason and Jack H. Noble, "Atlas-based automatic internal auditory canal localization with a weakly-supervised 3D U-Net," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-77, 2023 (in press)
- [2]. Yike Zhang, Jack H. Noble, "Self-supervised registration and segmentation on ossicles with a single ground truth label," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-80, 2023 (in press)
- [3]. Erin L. Bratu, Ziteng Liu, Jack H. Noble, "Influence of auditory nerve fiber model parameters on electrical stimulus thresholds," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-80, 2023 (in press)
- [4]. Ange Lou, Xing Yao, Ziteng Liu, Jintong Han, Jack H. Noble, "Self-supervised surgical instrument 3D reconstruction from a single camera image," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-14, 2023 (in press)
- [5]. Rueben A. Banalagay and Jack H. Noble, "Automatic chorda tympani segmentation with weakly supervised conditional adversarial networks," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-29, 2023 (in press)
- [6]. Yubo Fan, Mohammad M. R. Khan, Han Liu, Jack H. Noble, Robert F. Labadie, Benoit M. Dawant, "Temporal bone CT synthesis for MR-only cochlear implant preoperative planning," Proceedings of the SPIE Conference on Medical Imaging, vol. 12466, pp. 12466-50, 2023 (in press)
- [7]. Hannah G. Mason and Jack H. Noble, "Automatic Internal Auditory Canal Segmentation Using a Weakly Supervised 3D U-Net," Proceedings of the SPIE Conference on Medical Imaging, vol. 12034, pp. 12034-63, 2022.
- [8]. Mohammad M.R. Khan, Rueben Banalagay, Robert F. Labadie, and Jack H. Noble, "Sensitivity of intra-cochlear anatomy segmentation methods to varying image acquisition parameters," Proceedings of the SPIE Conference on Medical Imaging, vol. 12034, pp. 12034-16, 2022.
- [9]. Rueben Banalagay and Jack H. Noble, "Active Shape Models with Locally Weighted Components," Proceedings of the SPIE Conference on Medical Imaging, vol. 12032, pp. 12032-42, 2022.
- [10]. Ziteng Liu and Jack H. Noble, "Patient-specific electro-anatomical modeling of cochlear implants using deep neural networks," Proceedings of the SPIE Conference on Medical Imaging, vol. 12034, pp. 12034-14, 2022.
- [11]. Yubo Fan, Rueben A Banalagay, Nathan D Cass, Jack H Noble, Kareem O Tawfik, Robert F Labadie, Benoit M Dawant, "Automatic Segmentation of Intracochlear Anatomy in MR Images Using a Weighted Active Shape Model," Annu Int Conf IEEE Eng Med Biol Soc, pp. 3573-3576, 2021.
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- [13]. Ziteng Liu and Jack H. Noble, "Cochlear implant electric field estimation using 3D neural networks," Proceedings of the SPIE Conf. on Medical Imaging, 11598-47, 2021.
- [14]. Erin L. Bratu, Linsey Sunderhaus, Katelyn A. Berg, Robert Dwyer, Robert F. Labadie, Rene H. Gifford, Jack H. Noble, "Electrical stimulation overlap visualization for image-guided cochlear implant programming," Proceedings of the SPIE Conf. on Medical Imaging, 11598-85, 2021.
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- [27]. François-Xavier Carton, Jack Noble, Bodil Munkvold, Ingerid Reinertsen and Matthieu Chabanas, "Automatic segmentation of intraoperative ultrasound images of the brain using U-Net," Presented at SURGETICA 2019.
- [28]. Yujie Chi, Jianing Wang, Yiyuan Zhao, Jack Noble, Benoit Dawant, "A Deep-Learning-Based Method for the Localization of Cochlear Implant Electrodes in CT Images," Presented at the 2019 IEEE 16th Int'l Symp. On Biomedical Imaging.
- [29]. Kenneth Kragh Jensen, Olga A Stakhovskaya, Elizabeth Kolberg, Jack H Noble, Matt Goupell, Joshua G. W. Bernstein, "Pitch Matching: Electrode Location Or Procedural Artifact?," Presented at the 2019 Conference on Implantable Auditory Prostheses
- [30]. Katelyn Berg, Jack Noble, Benoit Dawant, Robert Dwyer, Robert Labadie, Rene Gifford, "Effect Of Number Of Active Electrodes And Channel Stimulation Rate On Speech Recognition And Sound Quality," Presented at the 2019 Conference on Implantable Auditory Prostheses
- [31]. Matthew J Goupell, Jack H Noble, Elizabeth Kolberg, Olga A Stakhovskaya, Kenneth K Jensen, Michael Hoa, Jeffery Kim, Joshua GW Bernstein, "Interaural Mismatches In Insertion Depth And Scala Location For Bilateral Cochlear-Implant Users," Presented at the 2019 Conference on Implantable Auditory Prostheses
- [32]. Ahmet Cakir, Robert T. Dwyer, Katelyn A. Berg, Rene H. Gifford, Jack H. Noble, "Auditory neural health imaging (ANHI) using patient-customized models," Presented at the 2019 Conference on Implantable Auditory Prostheses
- [33]. Joshua G.W. Bernstein, Kenneth K. Jensen, Olga A. Stakhovskaya, Jack H. Noble, Michael Hoa, H Jeffrey Kim, Robert Shih, Elizabeth R. Kolberg, Matthew J. Goupell, "Estimating interaural mismatch to inform individualized frequency mapping," Presented at the 2019 Conference on Implantable Auditory Prostheses
- [34]. Rueben A Banalagay, Robert F Labadie, Jack H Noble, "Insertion Depth of Pre-Curved Cochlear Implant Electrodes," Presented at the 2019 Combined Otolaryngology Spring Meeting.
- [35]. William G Morrel, Katherine E Riojas, Narendran Narasimhan, Robert J Webster III, Jack H Noble, Robert F Labadie, "Custom Mastoid-Fitting Templates to Improve Cochlear Implant Electrode Insertion Trajectory," Presented at the 2019 Combined Otolaryngology Spring Meeting.
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- [37]. William Morrel, Nauman Manzoor, Ashley Nassiri, Benoit Dawant, Jack Noble, Robert Labadie, "Precurved electrode insertion techniques affect final electrode position in temporal bones," Presented at the 2019 Combined Otolaryngology Spring Meeting.
- [38]. Ghassan Alduraibi, Rueben Banalagay, Robert F. Labadie, Jack H. Noble, "Automatic localization of the internal auditory canal for patient-specific cochlear implant modeling," Proceedings of the SPIE Conf. On Medical Imaging, vol. 10951, pp. 56, 2019
- [39]. Ahmet Cakir, Robert F. Labadie, Jack H. Noble, "Auditory nerve fiber segmentation methods for neural activation modeling," Proceedings of the SPIE Conf. On Medical Imaging, vol. 10951, pp. 55, 2019
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- [87]. Reda, F.A., Noble, J.H., Labadie, R.F., Dawant, B.M., "Automatic surface-based pre- to intra-operative CT registration for image-guided cochlear implant surgery," Presented at the Workshop on Biomedical Image Registration (WBIR), July 2012.
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EDUCATIONAL ACTIVITIES

Courses and lectures

2023	EECE 8396 – Special Topics: Medical Image Segmentation (Spring)
2022	EECE 8395 – Special Topics: Engineering for Surgery (Fall)
2022	EECE 8395 – Special Topics: Medical Image Segmentation (Spring)
2021	EECE 8395 – <i>New course</i> : Special Topics: Technical Methods in Surgery and Engineering (Fall)
2021	EECE 3214 – Signals and Systems (Spring)
2020	EECE 3214 – Signals and Systems (Fall)
2020	<i>New course</i> : Launched online course on Coursera: Introduction to Data, Signal, and Image Analysis in MATLAB (Summer); >1000 students have completed the course as of January 2023.
2020	EECE 8396 – Medical Image Segmentation (Spring)
2019	EECE 3214 – Signals and Systems (Fall)

2019	Guest lecturer for the course “Cochlear Implants” at Vanderbilt University School of Medicine (Fall)
2019	EECE 3214 – Signals and Systems (Spring)
2018	Guest lecturer for the course “Cochlear Implants” at Vanderbilt University School of Medicine (Fall)
2018	EECE 8395 – <i>New course</i> : Medical Image Segmentation (Fall)
2018	EECE 4252 – Signal Processing and Communications (Spring)
2017	Guest lecturer for the course “Advanced Image Processing” at Vanderbilt University
2016	High school outreach – Guest lecturer for medical diagnostics course at Mt. Juliet High School
2014	Taught course on programming with MATLAB for PAVE – Pre-college summer program at Vanderbilt University
2013	Undergraduate independent study advisor (EECS 295)
2013	Guest lecturer for the course “Advanced Image Processing” at Vanderbilt University
2011	Guest lecturer for the course “Advanced Medical Image Processing” at Vanderbilt University
2009	Substitute lecturer for the course “Signals and Systems” at Vanderbilt University
2008	Substitute lecturer for the course “Signals and Systems” at Vanderbilt University
2007	Teaching assistant for the course “Signals and Systems” at Vanderbilt University

Dissertation committees

2023	Ziteng Liu	Patient-specific modeling of cochlear implants
2023	Yubo Fan	Deep learning methods for cochlear implant electrode localization
2023	Bowen Xiang	Augmented reality for liver interventions
2022	Rueben Banalagay	An active shape model and machine learning for analyzing cochlear anatomy and other small shape libraries
2021	Katherine Riojas	Making cochlear-implant electrode array insertion less invasive, safer, and more effective through design, magnetic steering, and impedance sensing
2021	Franc.-Xav. Carton	Image segmentation and registration using machine learning for brain shift compensation in image-guided neurosurgery
2021	Katelyn Berg	The relationship between channel interaction and music perception with cochlear implants
2021	Abah Colette	Design of Continuum robots, sensing modalities, and situational awareness aids with applications to surgery and manufacturing
2021	Jianing Wang	Machine learning-based techniques for medical image registration and segmentation and a technique for patient-customized placement of cochlear implant electrode arrays
2021	Colin Hansen	Empirical and data-driven harmonization of diffusion weighted MRI
2021	Srijata Chakravorti	Application of image processing and statistical analysis to model patient outcomes in cochlear implantation and epilepsy surgery
2020	Michael Siebold	Algorithms for Advancing the Patient-Personalization of Preoperative Planning in Image-Guided Robotic Surgery
2019	Xiaochen Yang	Full Realization of Quantitative Cortical Brain Surface Measurement Through Stereo Pair Without Separate Tracking Technology
2019	Rashid Yasin	Perception Augmentation and Assistance for Improved Surgical Awareness
2019	Dongqing Zhang	Machine learning-based techniques for automating image-guided cochlear implant programming
2019	Ahmet Cakir	Patient specific electro-anatomical modeling of cochlear implants
2018	Yiyuan Zhao	Automatic techniques for cochlear implant CT image analysis
2017	Robert Harrigan	Optic Nerve Characterization using Magnetic Resonance Imaging: The Search for Biomarkers
2016	Yuan Liu	Improving image-guided preoperative planning in deep brain stimulation procedures
2015	Zhoubing Zhou	Automatic Segmentation of the Human Abdomen in Clinically Acquired CT
2014	Fitsum Reda	Automatic Segmentation of Structures and Registration of CT Images for Image-Guided Otologic Surgery and Cochlear Implant Programming

2013	Xue Yang	Robust Statistical Inference in Human Brain Mapping
<i>Master's thesis committees</i>		
2023	Jintong Han	Unsupervised learning methods for medical image segmentation
2021	Xujuan Sun	Synthesizing Micro-CT from CT of the inner ear with 3D-conditional GANs
2015	Kepra McBrayer	Two medical imaging processing techniques for use in acoustic neuroma removal and cochlear prosthetic implantation
<i>Primary Adviser</i>		
2022-Present	Minh Vu	Deep learning-based segmentation of the facial nerve
2021-Present	Ange Lou	Microscope video analysis techniques for image-guided cochlear implant surgery
2021-Present	Yike Zhang	Segmentation and registration of the ear structures between CT and microscope for image-guided cochlear implant surgery
2020-Present	Hannah Mason	Weak supervision learning for internal auditory canal localization
2019-Present	Erin Bratu	Methods for cochlear implant programming using patient customized models
2018-2022	Rueben Banalagay	An active shape model and machine learning for analyzing cochlear anatomy and other small shape libraries (Now a Data Scientist at Trilliant Health)
2018-Present	Ziteng Liu	Model-based image guided cochlear implant programming
2018-Present	Mohammad Khan	Image-guided cochlear implant electrode positioning techniques
2014-2019	Ahmet Cakir	Patient specific electro-anatomical modeling of cochlear implants (Now a Data Scientist at SFL Scientific)
<i>Co-Primary Advisor</i>		
2018-2021	Franc.-Xav. Carton	Model-based registration of intra-operative UltraSound and MR images for image-guided brain surgery
<i>Mentorship</i>		
2021-Present	Dingjie Su	Visualization techniques for cochlear implant interventions
2018-Present	Yubo Fan	Deep learning methods for CI image analysis
2015-Present	Srijata Chakravorti	Development of a CI imaging phantom & investigation of CI positioning vs outcomes
2015-Present	Jianing Wang	Deep learning methods for CI image analysis
2014-2019	Xiaochen Yang	Augmented reality guided cochlear implantation
2014-2019	Dongqing Zhang	Analysis of scope efficiency for cholesteatoma procedures (Now at Google)
2013-2018	Yiyuan Zhao	Development of image analysis techniques for image-guided cochlear implant programming (Now at Siemens Healthineers)
2013-2015	Kepra McBrayer	Image analysis for robotic acoustic neuroma procedures
2011-2014	Fitsum Reda	Development of image analysis techniques for computer aided cochlear implantation (Now at NVIDIA)
2011-2016	Yuan Liu	Development of image analysis techniques for deep brain stimulator procedures (Now at Google)
2011-2012	Antong Chen	Model-based segmentation of the neck for radiotherapy procedures (Now at Merck Pharmaceuticals)

Undergraduate Research Adviser

2021-2023	Rui Wang	3D Deep Learning techniques for processing Ultrasound Images
2021	Yiqi Zhao	Extensions on the Capabilities of 2D Image Processing of Ultrasound Images with Machine Learning Techniques
2021	Zifeng Liang	Image Processing for Naval Ultrasonic Imaging System
2019	Omer Babademez	Deep learning for active shape model segmentation of the cochlea
2018	Minh Vu	Shape analysis of the sinus tympanum for design of a transnasal middle ear endoscope
2018	Ghassan Alduraibi	Automatic localization of the internal auditory canal for patient specific cochlear implant modeling
2018	Jeffrey Zhang	Synthesis of μ CT from CT using cGANs
2013-2014	Rebecca Turok	Cochlear implantation simulation for surgical technique analysis

High School Research Adviser

2019	Jacob Gifford	Registration of histological images of cochlea specimens
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