



DELIVERABLE REPORT

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1) Introduction

This deliverable provides an overview of the LUCA project's dissemination activities from M37 to M64 of the project. Its purpose is to give a detailed account of all dissemination activities undertaken between February 1, 2019 and May 31, 2021.

2) Dissemination Activities during the last period (M37-M64)

In this section, we present a summary of all project-related outreach, communication, and dissemination activities during M37-M64 of the LUCA project. These include the publication of scientific papers, newsletters, development dissemination material, and updates on the project website as well as dissemination activities at conferences and congresses and on social media.

a. Publications

i. Scientific Publications

During this project period, the scientific partners published 11 journal articles and 8 conference papers related to the LUCA project:



#	Type	Title of the scientific publication	DOI	Authors	Title of the journal or equivalent	Public & private participation	Peer-review	Status	Open Access
1	Article in Journal	Coherent fluctuations in time-domain diffuse optics	10.1063/5.0011838	Lorenzo Colombo, Saeed Samaei, Pranav Lanka, Daniele Ancora, Marco Pagliazzi, Turgut Durduran, Piotr Sawosz, Adam Liebert, and Antonio Pifferi	APL Photonics	Yes	Yes	Published	Yes - Gold Open Access
2	Article in Journal	In vivo time-domain diffuse correlation spectroscopy above the water absorption peak	10.1364/OL.392355	L. Colombo, M. Pagliazzi, S. Konugolu Venkata Sekar, D. Contini, T. Durduran, and A. Pifferi,	Optics Letters	No	Yes	Published	Yes - Gold Open Access
3	Article in Journal	Instrument response function acquisition in reflectance geometry for time-resolved diffuse optical measurements	10.1364/BOE.380996	Ileana Pirovano, Rebecca Re, Alessia Candeo, Davide Contini, Alessandro Torricelli, and Lorenzo Spinelli	Biomedical Optics Express	No	Yes	Published	Yes - Gold Open Access
4	Publication in conference proceeding/workshop	A wearable time domain near infrared spectroscopy system	10.1117/12.2544271	M. Lacerenza, M. Buttafava, M. Renna, A. Torricelli, A. Tosi, A. Dalla Mora, F. Zappa, A. Pifferi, D. Contini	Proc. SPIE 11237, Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables, 1123702 (21 February 2020)	No	Yes	Published	Yes - Green Open Access
5	Publication in conference proceeding/workshop	Systematic study of the effect of ultrasound gel on the performances of time-domain diffuse optics and diffuse correlation spectroscopy	10.1364/BOE.10.003899	Laura Di Sieno, Davide Contini, Giuseppe Lo Presti, Lorenzo Cortese, Tony Mateo, Bogdan Rosinski, Elena Venturini, Pietro Panizza, Mireia Mora, Gloria Aranda, Mattia Squarcia, Andrea Farina, Turgut Durduran, Paola Taroni, Antonio Pifferi, and Alberto Dalla Mora	Biomedical Optics Express	Yes	Yes	Published	Yes - Gold Open Access
6	Article in Journal	Effects of the instrument response function and the gate width in time-domain diffuse correlation spectroscopy: model and validations	10.1117/1.NPh.6.3.035001	Lorenzo Colombo, Marco Pagliazzi, Sanathana Konugolu Venkata Sekar, Davide Contini, Alberto Dalla Mora, Lorenzo Spinelli, Alessandro Torricelli, Turgut Durduran, Antonio Pifferi	Neurophotonics	No	Yes	Published	Yes - Gold Open Access
7	Article in Journal	Self-calibrating time-resolved near infrared spectroscopy	10.1364/BOE.10.002657	Stanislaw Wojtkiewicz, Anna Gerega, Marta Zanoletti, Aleh Sudakou, Davide Contini, Adam Liebert, Turgut Durduran, and Hamid Dehghani	Biomedical Optics Express	No	Yes	Published	Yes - Gold Open Access
8	Publication in conference	Multi-wavelength dual-detection channel system for	10.1117/12.2509706	Marco Renna, Mauro Buttafava, Anurag Behera, Marta Zanoletti, Laura Di Sieno, Alberto Dalla Mora, Davide Contini, Alberto Tosi	Proc. SPIE 10874, Optical Tomography and	No	Yes	Published	Yes - Green



	Proceeding/workshop	time-resolved near-infrared spectroscopy			Spectroscopy of Tissue XIII, 1087408 (1 March 2019)				Open Access
9	Publication in conference proceeding/workshop	In vivo time-domain diffuse correlation spectroscopy of the human muscle above 1000 nm	10.1117/12.2527065	L. Colombo, M. Pagliazzi, S. Konugolu Venkata Sekar, D. Contini, A. Dalla Mora, L. Spinelli, A. Torricelli, T. Durduran, A. Pifferi	Proc. SPIE 11074, Diffuse Optical Spectroscopy and Imaging VII, 110742V (11 July 2019)	No	Yes	Published	Yes - Green Open Access
10	Publication in conference proceeding/workshop	Effects of ultrasound impedance matching fluids on diffuse optical measurements	10.1117/12.2526925	Laura Di Sieno, Davide Contini, Giuseppe Lo Presti, Lorenzo Cortese, Tony Mateo, Bogdan Rosinski, Elena Venturini, Pietro Panizza, Mireia Mora, Gloria Aranda, Mattia Squarcia, Andrea Farina, Turgut Durduran, Paola Taroni, Antonio Pifferi, Alberto Dalla Mora	Proceedings Volume 11074, Diffuse Optical Spectroscopy and Imaging VII; 110742T (2019)	Yes	Yes	Published	Yes - Green Open Access
11	Publication in conference proceeding/workshop	The SiPM revolution in time-domain diffuse optics	10.1016/j.nima.2020.164411	Alberto Dalla Mora, Laura Di Sieno, Anurag Behera, Paola Taroni, Davide Contini, Alessandro Torricelli, Antonio Pifferi	Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment	No	Yes	Published	Yes - Green Open Access
12	Publication in conference proceeding/workshop	The Curse of Big Data in Diffuse Optical Spectroscopic Tomography: The LUCA approach	10.1364/OTS.2020.SM2D.3	Hamid Dehghani and Stanislaw Wojtkiewicz	Biophotonics Congress: Biomedical Optics 2020 (Translational, Microscopy, OCT, OTS, BRAIN), OSA Technical Digest (Optical Society of America, 2020)	Yes	Yes	Published	The publication will not be available under Open Access
13	Article in Journal	Non-Invasive Estimation of Intracranial Pressure by Diffuse Optics: A Proof-of-Concept Study	10.1101/2020.05.21.20109256	Jonas B. Fischer, Ameer Ghouse, Susanna Tagliabue, Federica Maruccia, Anna Rey-Perez, Marcelino Báguena, Paola Cano, Riccardo Zucca, Udo M. Weigel, Juan Sahuquillo, Maria A. Poca, and Turgut Durduran	Journal of Neurotrauma	Yes	Yes	Published	Yes - Green Open Access





14	Article in Journal	Time resolved speckle contrast optical spectroscopy at quasi-null source-detector separation for non-invasive measurement of microvascular blood flow	10.1364/BOE.418882	Marco Pagliuzzi, Lorenzo Colombo, Ernesto E. Vidal-Rosas, Tanja Dragojević, Veronika Parfentyeva, Joseph P. Culver, Sanathana Konugolu Venkata Sekar, Laura Di Sieno, Davide Contini, Alessandro Torricelli, Antonio Pifferi, Alberto Dalla Mora, and Turgut Durduran	Biomedical Optics Express	Yes	Yes	Published	Yes - Gold Open Access
15	Article in Journal	Blood flow response to orthostatic challenge identifies signatures of the failure of static cerebral autoregulation in patients with cerebrovascular disease	10.1186/s12883-021-02179-8	Clara Gregori-Pla, Rickson C Mesquita, Christopher G Favilla, David R Busch, Igor Blanco, Peyman Zirak, Lisa Kobayashi Frisk, Stella Avtzi, Federica Maruccia, Giacomo Giacalone, Gianluca Cotta, Pol Camps-Renom, Michael T Mullen, Joan Martí-Fàbregas, Luís Prats-Sánchez, Alejandro Martínez-Domeño, Scott E Kasner, Joel H Greenberg, Chao Zhou, Brian L Edlow, Mary E Putt, John A Detre, Arjun G Yodh, Durduran Turgut, and Raquel Delgado-Mederos	BMC Neurology	Yes	Yes	Published	Yes - Gold Open Access
16	Article in Journal	Neurodevelopmental profile in children with benign external hydrocephalus syndrome. a pilot cohort study	10.1007/s00381-021-05201-z	Federica Maruccia, Laura Gomariz, Katuska Rosas, Turgut Durduran, Fernando Paredes-Carmona, Juan Sahuquillo, and Maria A. Poca.	Child's Nervous System	Yes	No	Published	Yes - Green Open Access
17	Article in Journal	Recipes for diffuse correlation spectroscopy instrument design using commonly utilized hardware based on targets for signal-to-noise ratio and precision	10.1364/BOE.423071	Lorenzo Cortese, Giuseppe Lo Presti, Marco Pagliuzzi, Davide Contini, Alberto Dalla Mora, Hamid Dehghani, Fabio Ferri, Jonas B. Fischer, Martina Giovannella, Fabrizio Martelli, Udo M. Weigel, Stanislaw Wojtkiewicz, Marta Zanoletti, and Turgut Durduran	Biomedical Optics Express	Yes	Yes	Published	Yes - Gold Open Access
18	Article in Journal	The LUCA device: a multi-modal platform combining diffuse optics and ultrasound imaging for thyroid cancer screening	10.1364/BOE.416561	Lorenzo Cortese, Giuseppe Lo Presti, Marta Zanoletti, Gloria Aranda, Mauro Buttafava, Davide Contini, Alberto Dalla Mora, Hamid Dehghani, Laura Di Sieno, Sixte de Fraguier, Felicia A. Hanzu, Mireia Mora Porta, An Nguyen-Dinh, Marco Renna, Bogdan Rosinski, Mattia Squarcia, Alberto Tosi, Udo M. Weigel, Stanislaw Wojtkiewicz, and Turgut Durduran.	Biomedical Optics Express	Yes	Yes	Published	Yes - Gold Open Access
19	Article in Journal	Wearable and wireless time-domain near-infrared spectroscopy system for brain and muscle hemodynamic monitoring	10.1364/BOE.403327	Michele Lacerenza, Mauro Buttafava, Marco Renna, Alberto Dalla Mora, Lorenzo Spinelli, Franco Zappa, Antonio Pifferi, Alessandro Torricelli, Alberto Tosi, and Davide Contini	Biomedical Optics Express	No	Yes	Published	Yes - Gold Open Access

ii. Newsletter

Between M37 and M64, the three issues of the LUCA newsletter were sent out in May 2019, May 2020, and May 2021 (in preparation). The fourth issue in May 2019 featured articles on the first in vivo tests in humans using the LUCA device, on LUCA's joint work with other H2020 projects as part of the Common Dissemination Booster, on the 5th Consortium General Assembly Meeting, and an interview with Udo Weigel from Hemophotonics. The fifth issue in May 2020 provided an update on the project's status amid the COVID-19 pandemic and LUCA's collaboration with the composer and sound artist Reiko Yamada. The content of the final issue of the newsletter features a news item on the article published in Biomedical Optics Express regarding the final LUCA device and results obtained from the preclinical studies, a news item summarizing the symposium that took place in November of 2020 as well as final words from Turgut Durduran.

All newsletters are available in both pdf and html format and were distributed via email (using Mailchimp) to the project's contact list, which is based on the EIBIR contact database with over 900 contacts, and through social media. The two issues reached 98-99% of subscribers with open rates between 24.6% and 26%, which is well in line with the audience average, and click rates of 1.5% and 1.3%. We expect to have the same reach with the final issue as well. Moreover, LUCA was featured in three editions of the EIBIR Research Newsletter in March 2019, December 2019, and November 2020, which was sent to over 960 contacts with open rates between 25.9% and 33%.

iii. Other Publications

During the last reporting period, the LUCA partners published five non-scientific articles:

Type of Dissemination and Communication activities	Title and details	Type of audience reached	Estimated number of persons reached
Non-scientific and non-peer reviewed publications (popularised publications)	LUCA featured in article in congress newspaper ECR Today at ECR 2019	Scientific Community (higher education, research)	1,500
Non-scientific and non-peer reviewed publications (popularised publications)	LUCA featured in article in congress newspaper ECR Today at ECR 2020	Scientific Community (higher education, research)	1,500
Non-scientific and non-peer reviewed publications (popularised publications)	Article in EIBIR Annual Report 2018	Scientific Community (higher education, research)	250
Non-scientific and non-peer reviewed publications (popularised publications)	Article in EIBIR Annual Report 2019	Scientific Community (higher education, research)	250
Non-scientific and non-peer reviewed publications	Article in EIBIR Annual Report 2020	Scientific Community (higher education, research)	250



(popularised publications)			
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In addition, a news release entitled “An innovative non-invasive tool for thyroid cancer screening” was published on occasion of ECR 2019 on February 26, 2020. It was sent out to a distribution list of over 500 media contacts and also made available via the EC public repository CORDIS. Most prominently, the press release triggered a [TV interview](#) with Médecine TV who produce Le JT de l'ECR. Médecine TV run a YouTube channel with over 8,900 subscribers.

b. Website

Over the course of the period M37-M54, the [LUCA project website](#) was regularly updated. News items were added announcing project-related activities and events and reporting on the project progress.

Google Analytics was used to monitor the traffic on the LUCA website during most of the project lifetime. Following the recommendation by the European Commission to consider suitable alternatives, MATOMO was installed as a new analytics tool. Between February 2019 and May 2021, over 5,500 sessions were recorded. Most sessions were recorded in Spain (899), Italy (over 770), and the United States (over 630). In total, 4,838 users visited the site from over 100 countries around the globe. Most traffic to the website has come via organic search on search engines such as google, direct visits or via referrals from other websites. Most referrals were recorded from everyphotoncounts.com (website by LUCA beneficiary POLIMI) and the POLIMI, ICFO, HEMO and EIBIR websites.



Laser and Ultrasound Co-analyzer for Thyroid Nodules (LUCA)

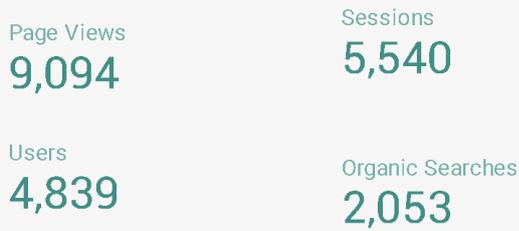
Website Summary

Data from Google Analytics & MATOMO

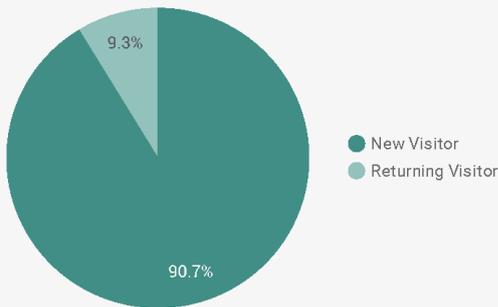
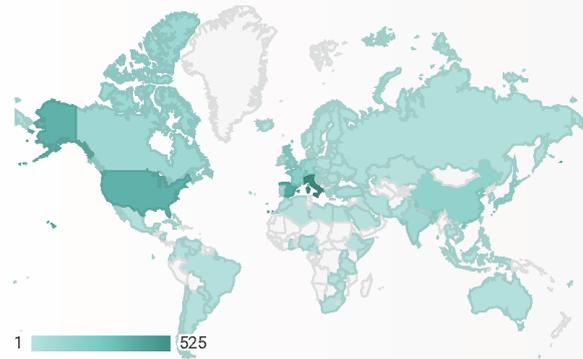


1 Feb 2019 - 31 May 2021

How are site sessions trending?



What are the top countries by sessions?



Country	Users	Sessions
1. United States	595	635
2. Italy	556	771
3. Spain	570	899
4. China	407	415
5. France	235	276
6. United Kingdom	204	207
7. Germany	165	180
8. India	122	144
9. Canada	118	127
10. Japan	118	123
11. Netherlands	100	155
12. Turkey	73	91
13. Austria	65	297
14. Brazil	63	63
15. Russia	60	66
16. Belgium	59	73
17. Malaysia	49	50
18. Singapore	45	65
19. Taiwan	46	48
20. Portugal	42	51

Which channels are driving engagement?

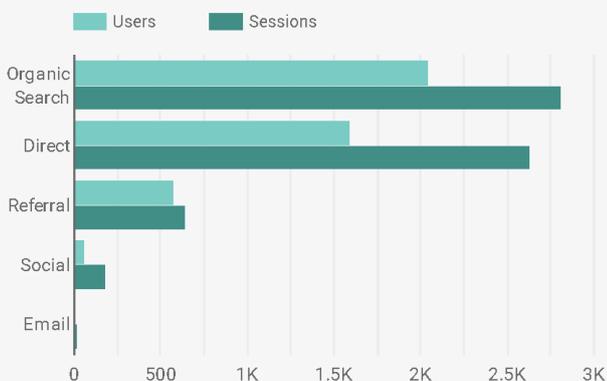


Figure 1: LUCA Website Traffic Feb 19 - May 21

c. Videos

In February 2019, video explaining the science behind the LUCA project and targeted towards the medical community was released: “[The LUCA Project: Developing an innovative tool for thyroid cancer screening](#)”. In September, a [video featuring the LUCA partners](#) was added. To disseminate the videos, they were uploaded the project’s YouTube channel, embedded in the project website, and shared via different media channels. A QR code to the video focussing on the technology was included in the updated project folder and the link was distributed in the press release distributed in February 2019.

During M37-M64, the three LUCA videos gathered over 900 views and over 2,800 impressions on YouTube. In addition, it was prominently shown during European Congress of Radiology 2019 at the exhibition at the EIBIR booth (see Fig. 14) and repeatedly played during breaks during the European Congress of Radiology 2020 and 2021 virtual congresses.

In addition, in April 2021, a video targeting the general public was created as part of the ICFO Series “Clara and Bob”. The [video](#) explains the basics of the optics involved in LUCA and other photonics devices. The video was shared on the LUCA website and through the LUCA social media channels. The video has 393 views and reached 1.3K impressions on YouTube.

d. Social Media

In June 2019, following a recommendation at the second review meeting, a dedicated LUCA Twitter account was established: @LUCA_H2020. Since then, the account has received more than 70,000 impressions. Overall, social medial activities were carried out on occasion of partners’ scientific presentations and other activities at meetings and congresses, paper and newsletter publications, and project meetings, or tying in with global events such as World Cancer Day and the European Action Week Against Cancer. A major effort was of course also made in anticipation of and during the webinar and panel discussion forming the LUCA International Innovation conference in November 2020. Among the most successful tweets via the LUCA account were:



Figure 2: Tweet during OSA Biophotonics 2020 (over 3,000 impressions)

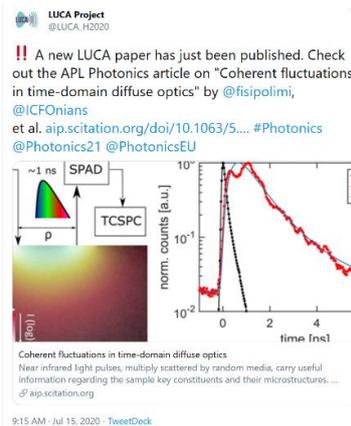


Figure 3: Tweet on paper publication (over 2,100 impressions)



Figure 4: Tweet promoting fifth newsletter (over 2,500 impressions)



Figure 5: Tweet announcing the LUCA panel discussion (over 2,700 impressions)



Figure 6: Tweet on LUCA conference recordings (over 3,800 impressions)



Figure 7: Tweet promoting LUCA on World Cancer Day 2021 (over 2,800 impressions)

In addition, promotion of the LUCA project via the partners' social media channels continued.



Figure 8: Tweet by T. Durduran (ICFO)

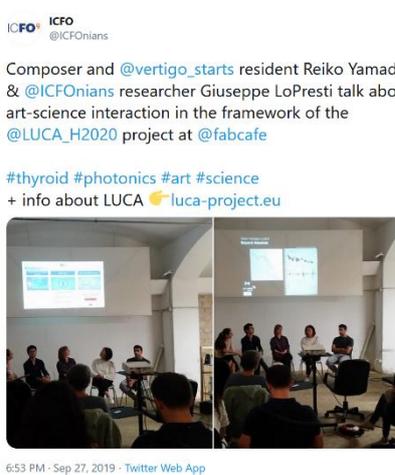


Figure 2: Tweet by ICFO



Figure 3: Tweet by EIBIR



Figure 4: Tweet by H. Dehghani (UoB)



Figure 5: Tweet by POLIMI



Figure 6: Tweet by EIBIR

e. Events

i. Presentations

Over the course of the third reporting period, the LUCA partners delivered presentations on LUCA and promoted the project at scientific conferences. The table below provides an overview of these presentations, invited, and contributed talks:

Activity	Title	Audience	Estimated no reached
Participation to a conference	SPIE BIOS 2019 (POLIMI)	Scientific Community (higher education, research)	200
Participation to a conference	Internal seminar, Department of Neurology, Delft, Netherlands, April 2019. Erasmus Medical Center. Turgut Durduran (ICFO): "Diffuse optical neuro-monitoring for ischemic stroke: current status and future prospects."	Scientific Community (higher education, research)	20
Participation to a conference	European Conferences on Biomedical Optics (ECBO) 2019, invited talk, Munich, Germany, 2019. SPIE/OSA. Clara Gregori-Pla, Rickson C. Mesquita, Christopher G. Favilla, David R. Busch, Igor Blanco, Lisa Kobayashi Frisk, Pol Camps-Renom, Michael T. Mullen, Joan Martí-Fàbregas, Luís Prats-Sánchez, Alejandro Martínez-Domeño, Raquel Delgado-Mederos, John A. Detre, Arjun G. Yodh, and Turgut Durduran (ICFO): "A mild orthostatic challenge shows impairment of cerebrovascular autoregulation on the ipsilesional hemisphere of ischemic stroke patients."	Scientific Community (higher education, research)	150
Participation to a conference	European Conference on Biomedical Optics 2019 (Munich, Germany). Lorenzo Cortese (ICFO): "Pilot measurement of the microvascular blood flow of thyroid nodules by diffuse optics."	Scientific Community (higher education, research)	150
Participation to a conference	European Conference on Biomedical Optics 2019 (Munich, Germany). Lorenzo Cortese (ICFO): "The LUCA device - Laser and Ultrasound Co-Analyzer for Thyroid Nodules."	Scientific Community (higher education, research)	150
Participation to a conference	European Conference on Biomedical Optics 2019 (Munich, Germany) (POLIMI)	Scientific Community (higher education, research)	200
Participation to a conference	164th ICB Seminar on Light and Optics in Medical Diagnosis, Warsaw, Poland, May 2019. International Centre of Biocybernetics. Turgut Durduran (ICFO): "Correlates of cerebral vasoreactivity measured by diffuse correlation spectroscopy (DCS) as biomarkers of brain injury in acute ischemic stroke."	Scientific Community (higher education, research)	100
Organisation of a Conference	27th International Conference on Advanced Laser Technologies (ALT 19), Prague, Czech Republic, September 2019. ALT. Turgut Durduran (ICFO): "Non-invasive measurement of cerebral blood flow as a biomarker injury, therapy and recovery."	Scientific Community (higher education, research)	200
Participation to an event other than a conference or workshop	1st ICFO-UNAM International School on Frontiers of Light, Queretaro, Mexico, October 2019. ICFO-UNAM. Turgut Durduran (ICFO): "Non-invasive, deep tissue monitoring and imaging with light: foundations and clinical applications."	Scientific Community (higher education, research)	100
Participation to a conference	Neuro-critical care departmental seminar, volume Invited talk, Philadelphia, USA, November 2019. University of Pennsylvania. Turgut Durduran (ICFO): "Bedside, non-invasive measurement of cerebral hemodynamics and oxygen metabolism in neurocritical care and more."	Scientific Community (higher education, research)	50

Participation to a conference	Advances in biomedical optics seminar series, volume Invited talk, Philadelphia, USA, November 2019. Center for Magnetic Resonance and Optical Imaging. Turgut Durduran (ICFO): "Deep tissue blood flow measurements with light: where are we now, and, where to next?"	Scientific Community (higher education, research)	50
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). (UoB)	Scientific Community (higher education, research)	100
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). Lorenzo Cortese (ICFO): "Effects of Different Hardware and Measurement Parameters on Diffuse Correlation Spectroscopy"	Scientific Community (higher education, research)	150
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). Lorenzo Cortese: "LUCA Device: A Multi-Wavelength Time-Resolved Spectroscopy and Diffuse Correlation Spectroscopy Device with an Integrated Clinical Ultrasound Module/Probe."	Scientific Community (higher education, research)	150
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). Jonas B. Fischer, Ameer Ghouse, Susanna Tagliabue, Federica Maruccia, Anna Rey-Perez, Marcelino Báguena, Paola Cano, Riccardo Zucca, Udo M. Weigel, Juan Sahuquillo, Maria A. Poca, and Turgut Durduran: "Non-invasive estimation of intracranial pressure by diffuse correlation spectroscopy."	Scientific Community (higher education, research)	100
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). Lisa Kobayashi Frisk, Jonas B. Fischer, Daniel Guisado Alonso, Clara Gregori Pla, Izaskun Belmonte Jimeno, Anna Bosch de Basea Gomez, Marta Navarro Roman, Udo M. Weigel, Joan Martí-Fàbregas, Raquel Delgado-Mederos, and Turgut Durduran: "Diffuse optical evaluation of hemodynamic and metabolic biomarkers towards guiding management in acute ischemic stroke."	Scientific Community (higher education, research)	100
Participation to a conference	Biophotonics Congress: Biomedical Optics 2020 (Online conference). (POLIMI)	Scientific Community (higher education, research)	200
Participation to a workshop	SiPM Workshop: from fundamental research to industrial applications (POLIMI)	Scientific Community (higher education, research)	100
Participation to a conference	Photonics Online Meetup 2020 (http://photonicsonlinemeetup.org/). Lorenzo Cortese (ICFO): "LUCA Device: A Multi-Wavelength Time-Resolved Spectroscopy and Diffuse Correlation Spectroscopy Device with an Integrated Clinical Ultrasound Module/Probe."	Scientific Community (higher education, research)	100
Participation to a conference	Saratov Fall Meeting 2020, Saratov State University, Saratov, Russia, September 2020. Marco Pagliuzzi, Lorenzo Cortese, Umut Karadeniz, Jaume Mesquida, Turgut Durduran and "on behalf of HEMOCOVID-19 consortium": "Adapting to a pandemic & an international clinical trial with diffuse optics.""	Scientific Community (higher education, research)	200
Participation to a conference	fNIRS Datablitz 2020 (online conference), Society for functional Near-infrared Spectroscopy (sfNIRS), October 2020. Turgut Durduran: "Hybrid diffuse optical technologies for neuro-monitoring (and more) in the clinics."	Scientific Community (higher education, research)	150
Participation to a conference	Photonics in the Fight Against COVID-19, SPIE online forum (online conference), October 2020.	Scientific Community (higher education, research)	100

	Turgut Durduran: "Adapting to a pandemic & an international clinical trial with diffuse optics."	education, research)	
Participation to a conference	Imaging Physics department colloquium, Delft University of Technology, Netherlands, February 2021. Turgut Durduran: "Peeking deep (>1 cm) inside the body with diffuse light: fundamentals, instrumentation and a clinical journey."	Scientific Community (higher education, research)	70
Participation to a conference	Cerebral blood flow virtual seminar series 2021, Cerebral autoregulation network (CAR-NET) (online conference), February 2021. Turgut Durduran: "Clinical examples of estimating static and dynamic autoregulation in patients with diffuse correlation spectroscopy."	Scientific Community (higher education, research)	150
Participation to a conference	Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2021 (online conference), SPIE, San Francisco, CA, USA, March 2021. Turgut Durduran. Panellist networking session on covid-19 for conference 11626.	Scientific Community (higher education, research)	100
Participation to a conference	Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2021 (online conference), SPIE, San Francisco, CA, USA, March 2021. Turgut Durduran, Marco Pagliuzzi, Lorenzo Cortese, U Karadeniz, J Mesquida, and "on behalf of HEMOCOV-19 consortium": "HEMOCOV-19: an international project evaluating microvascular and endothelial dysfunction in COVID-19 patients with diffuse optics."	Scientific Community (higher education, research)	100
Participation to a conference	Photonics West 2021, (online conference), SPIE, San Francisco, CA, USA, March 2021. Lorenzo Cortese, Giuseppe Lo Presti, Pablo Fernandez Esteberena, Marta Zanoletti, Mauro Buttafava, Marco Renna, Davide Contini, Alberto Dalla Mora, Antonio Pifferi, Paola Taroni, Alberto Tosi, Gloria Aranda, Sabina Ruiz Janer, Mattia Squarcia, Felicia Hanzu, Mireia Mora Porta, Stanislaw Wojtkiewicz, Hamid Dehghani, Udo M. Weigel, Sixte de Fraguier, An Nguyen-Dinh, Bogdan Rosinski, and Turgut Durduran: "Preliminary clinical study of the potential of multi-modal optical/ultrasound LUCA platform for improved thyroid cancer screening"	Scientific Community (higher education, research)	100
Participation to a conference	Photonics West 2021, (online conference), SPIE, Neurotechnologies Plenary, San Francisco, CA, USA, March 2021. Turgut Durduran: "Seeking new biomarkers with diffuse correlation spectroscopy and next generation devices for transcranial assessment of cerebral hemodynamics."	Scientific Community (higher education, research)	150
Participation to a conference	Photonics West 2021, (online conference), SPIE, Neurotechnologies Plenary, San Francisco, CA, USA, March 2021. Pablo R. Fernandez Esteberena, Clara Vilches, Maria del Mar Martinez Lozano, Ignacio de Miguel, Oriol Casanovas, Romain Quidant, and Turgut Durduran: "A toolbox for the comprehensive, real-time optimization of plasmonic photothermal therapy demonstrated on an orthotopic renal tumor model."	Scientific Community (higher education, research)	150
Participation to a conference	Photonics West 2021, (online conference), SPIE, San Francisco, CA, USA, March 2021. Lorenzo Cortese, Giuseppe Lo Presti, Marco Pagliuzzi, Jonas B. Fischer, Martina Giovannella, Marta Zanoletti, Fabio Ferri, Fabrizio Martelli, Alberto Dalla Mora, Davide Contini, Stanislaw Wojtkiewicz, Hamid Dehghani, Udo M. Weigel, and Turgut Durduran: "Optimization of diffuse correlation spectroscopy instrumental and experimental parameters based on precision targets."	Scientific Community (higher education, research)	150

Participation to a conference	Photonics West 2021, (online conference), SPIE, San Francisco, CA, USA, March 2021. Jonas B. Fischer, Susana Tagliabue, Federica Maruccia, Amelia Jieménez-Sanchez, Eashani Sathialingam, Wesley B. Baker, Aykut Eken, Ameer Ghouse, Anna Rey-Perez, Marcelino Báaguena, Katuska Rosas, Ofer Sadan, Prem A. Kandiah, Owen B. Samuels, Ramani Balu, Riccardo Zucca, Udo M. Weigel, David R. Busch, Erin M. Buckley, Arjun G. Yodh, DJ Licht, AW Kofke, MA Poca, G Piella, J Sahuquillo, and Turgut Durduran: “Non-invasive estimation of intracranial pressure by fast diffuse correlation spectroscopy: a multi-center study.”	Scientific Community (higher education, research)	100
Participation to a conference	Photonics West 2021, (online conference), SPIE, San Francisco, CA, USA, March 2021. Stella Avtzi, U Cristina Udina, Veronika Parfentyeva, Míriam Mota, Carmina Castellano-Tejedor, Luis Soto-Bagaria, Marco Inzitari, and Turgut Durduran: “Functional diffuse correlation spectroscopy measurements on cognitively healthy and mild cognitive impaired populations during single and dual motor tasks.”	Scientific Community (higher education, research)	100
Participation to a conference	XXIIIé Congrès de la Societat Catalana d’Endocrinologia i Nutrició (online). November 2020. Gloria Aranda (IDIBAPS): “Estudio Clínico Piloto con el Dispositivo Multimodal LUCA para optimizar el diagnóstico del Cáncer de Tiroides: Resultados preliminares”	Scientific Community (higher education, research)	200
Participation to a conference	European Congress of Endocrinology (online). May 2021. Gloria Aranda (IDIBAPS): “Pilot study with the LUCA device to optimize the diagnosis of thyroid cancer: preliminary results”	Scientific Community (higher education, research)	500

ii. Promotional Activities

In addition to scientific presentations, the partners also distributed dissemination material on the LUCA project at international conferences, meetings, and events to inform about the project and reach out to end-users, researchers, industry representatives, and the general public:

Type of Dissemination and Communication activities	Title and details	Type of audience reached	Estimated number of persons reached
Participation to a conference	LUCA dissemination material for distribution at EIBIR Lounge at ECR 2019	Scientific Community (higher education, research) Industry	200
Participation to an event other than a conference or workshop	MEET ME TONIGHT 2019 (POLIMI, Milano)	General Public	800
Exhibition	IEEE Ultrasonic International Symposium, Glasgow 2019. LUCA probe presented at VERMON’s booth.	Scientific Community (higher education, research) Industry	700
Participation to a conference	LUCA dissemination material for distribution at EIBIR virtual lounge at ECR 2020, LUCA video shown during breaks	Scientific Community (higher education, research) Industry	200
Participation to an event other than a conference or workshop	INTERNATIONAL STEM AWARDS 2020	General Public	100
Participation to a conference	LUCA dissemination material for distribution at EIBIR virtual lounge at ECR 2021, LUCA video shown during breaks	Scientific Community (higher education, research) Industry	200

Organisation of a Conference	Synergy of light & sound for disease screening and therapy monitoring, 2020	Scientific (higher research) Industry	Community education,	97
Participation to an event other than a conference or workshop	LUCA Panel Discussion: Diffuse optics and clinical ultrasound, exploring new applications	Scientific (higher research)	Community education,	63

For example, the following set-up (Fig. 14) including a thyroid model and a model probe was designed for ECR 2019 explaining the features of the LUCA device. Alongside the exhibit, the second LUCA video focussing on the science behind the project was shown.



Figure 14: LUCA exhibit at ECR 2019

In addition to the exhibit, the LUCA roll-up was put up at ECR 2019 and an updated version of the LUCA folder (e.g. including a link to the project’s YouTube channel) disseminated at the EIBIR Lounge. For ECR 2020, another extensive update of the folder was done to include an update on the project progress and more detailed information on the LUCA device:



PROGRESS AND OUTLOOK

“With the LUCA prototype ready for clinical testing, we have completed a major milestone in our project. Once LUCA is applied in the clinics, we expect a significant reduction of invasive procedures, better clinical decision-making and improved thyroid cancer diagnosis.”

Prof. Turgut Durduran
Project Coordinator of the LUCA Project

THE LUCA DEVICE

Our device consists of 6 core parts:

- OPTICAL MAIN MODULE**
 - Principal control unit operating the optical modules and managing communication with the Ultrasound Module and Data Analysis System
- DIFFUSE CORRELATION SPECTROSCOPY (DCS) MODULE**
 - Measures micro-vascular blood flow
- NEAR-INFRARED TIME RESOLVED SPECTROSCOPY (TRS) MODULE**
 - Measures blood oxygenation, blood volume, water concentration, lipid concentration, collagen content, and scattering
- DATA ANALYSIS SYSTEM**
 - Includes Near Infrared Fluorescence and Spectral Tomography (NIRFAST) toolboxes for DCS and TRS
 - Receives, processes and evaluates the optical and US data
 - Calculates hemodynamic parameters of thyroid and muscle tissues
- HYBRID OPTICS-US PROBE**
 - Acquires optical and US data
 - Provides optimised handling, skin sensation, fibre positioning precision, and laser safety features
- ULTRASOUND MODULE**
 - Primary user interface for medical doctors
 - Innovative software interface for integration of optical information

EXPECTED IMPACT OF LUCA

- Improved specificity of the thyroid screening process and corresponding earlier and faster diagnosis for effective treatment.
- Reduction of the number of unnecessary surgeries and associated co-morbidities, thus improving patients’ quality of life.
- Reduction of the socio-economic cost related to thyroid cancer and saving of hundreds of millions euro every year.
- Application of the LUCA device in breast, head and neck oncology, rheumatology, pediatric neurology and nephrology, and possibly clinical veterinarian medicine.



Figure 15: LUCA folder (rear)



In addition, a LUCA poster was created in January 2020 with general information about the project, an overview of the technology, the LUCA device and its modules, and an update on the current state of the clinical validation. The poster was made available at the virtual EIBIR Lounge during ECR 2020 and 2021 (Figure 16):

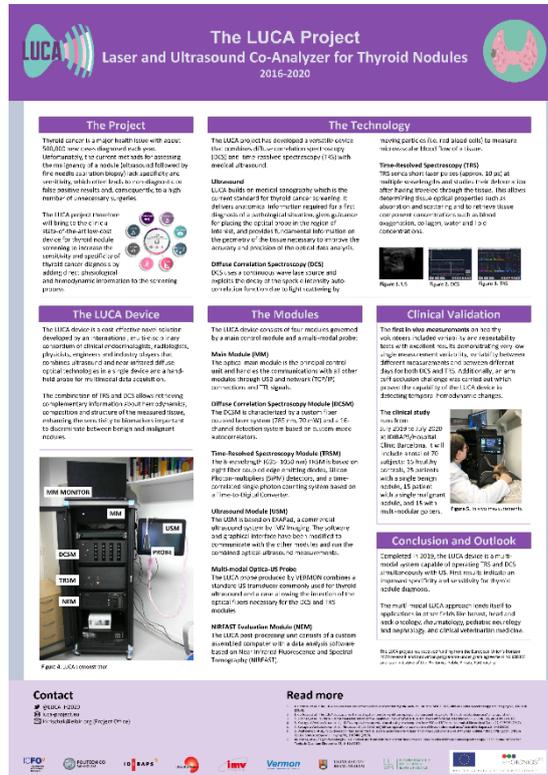


Figure 16: LUCA poster

Moreover, during both online congresses of the European Society of Radiology, the LUCA videos were shown between lectures:

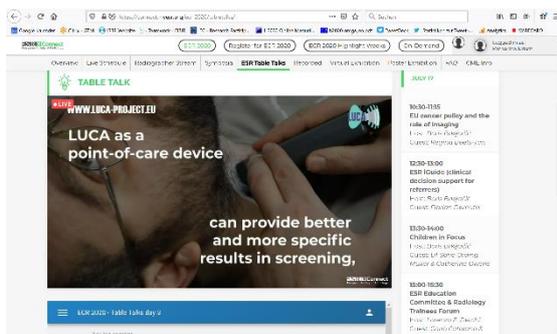


Figure 17: LUCA Video at virtual ECR 2020

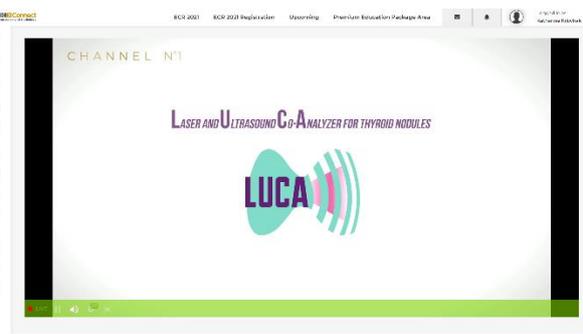


Figure 18: LUCA Video at virtual ECR 2021

iii. LUCA Innovation Conference

In addition to the external events, in November 2020, the LUCA consortium successfully organised two events: a public event and a closed panel discussion with participation of relevant stakeholders from end-user and research communities. Due to the COVID-19 pandemic, the conference was organised in an online format and split up in two sessions held on different dates. On November 5, 2020, a public webinar took place under the title “Synergy of light & sound for disease screening and



therapy monitoring: Update on technology and clinical studies with diffuse optics and ultrasound". A week later, on November 12, 2020, a closed panel discussion with expert speakers was held and relevant stakeholders were invited. The project's results were presented, and paths for clinical translation of the LUCA device as well as new opportunities for multi-modal imaging tools combining diffuse optics and medical ultrasound were explored in fruitful discussions.

The final programme of the public webinar was as follows:

- 15:30 – 15:40 **Introduction** (Davide Contini, Department of Physics, Politecnico di Milano, Italy)
- 15:40 – 16:10 **Diffuse optics: the path towards clinical translation** (Mitchell Schnall, Department of Radiology, Perelman School of Medicine at the University of Pennsylvania, USA)
- 16:10 – 16:40 **Introduction to the LUCA project** (Turgut Durduran, Medical Optics group, ICFO-The Institute of Photonic Sciences, Spain)
- 16:40 – 17:10 **Clinical results and perspectives of the LUCA project** (Mireia Mora, Endocrinology and Nutrition Department, Hospital Clinic of Barcelona, Spain)
- 17:10 – 17:30 **Q&A**

At the online panel discussion, two panels of experts discussed the paths of entry of new modalities in diagnostics and screening and new potential areas for application of multi-modal devices combining diffuse optics and medical ultrasound. The panels featured both researchers and clinicians:

17:00 – 17:10: **Introduction** by Turgut Durduran, Medical Optics Group Leader ICREA Professor, ICFO (The Institute of Photonic Sciences), Spain

Session 1

17:10 – 17:55: **Discussion on paths for entry of new modalities in diagnostics and screening**

- Mitchell Schnall, Chair of Department of Radiology, Perelman School of Medicine at the University of Pennsylvania, USA
- Laura Oleaga, Chair of Department of Radiology, Hospital Clinic of Barcelona, Spain
- Paola Taroni, Full professor at Department of Physics, Politecnico di Milano, Italy
- Josep Munuera del Cerro, Head of Department. Area of Quality, Innovation and Research at the Diagnostic Imaging Department, Hospital Universitari Sant Joan de Déu, Spain

17:55 – 18:05: *Break*

Session 2

18:05 – 18:50: **New application areas to explore.**

- Manuel Puig, Head of Endocrinology and Nutrition Service, Germans Trias i Pujol University Hospital, Spain
- Josep Taberner, Head of Medical Oncology Department, Vall d'Hebron University Hospital, Spain & Director of Vall d'Hebron Institute of Oncology (VHIO), Spain
- Jaume Mesquida, Consultant physician, Critical Care Department, Parc Taulí Hospital Universitari, Spain
- Marco Inzitari, Director of Intermediate Care & Research, Parc Sanitari Pere Virgil, Spain

18:50 – 19:00: **Closing remarks** by Turgut Durduran, Medical Optics Group Leader ICREA Professor, ICFO (The Institute of Photonic Sciences), Spain

The events were well attended. For the public webinar, 105 registrations were received. The final number of participants was 75 with researchers and clinicians joining from 13 countries around the globe. While most participants joined from European countries (AT, BE, DE, ES, FR, IT, NL, PL, PT, UK), there were also participants from the US, Taiwan, and the Philippines. For the closed online panel discussion, 54 attendees registered. Of these, 46 participated including 11 panellists and moderators. Participants joined from five European countries (AT, ES, FR, IT, UK) and the United States.

In preparation of the LUCA events, promotional activities were carried out. For this purpose, the following graphics were designed:



Figure 19: Public webinar announcement



Figure 20: Panel discussion announcement

The public webinar was promoted through various channels, including a newsletter announcement, targeted invitations to key opinion leaders, social media activities, inclusion in partner newsletters and promotion on partner websites as well as the LUCA project website. More details are reported in Deliverable 6.9 LUCA international innovation conference.

The public webinar presentations were recorded and made available on the project website and on the LUCA YouTube channel. Since November 2020, the videos were watched nearly 100 times and gathered over 500 impressions.

f. Collaboration Activities

Between October 2017 and November 2019, LUCA participated in the EC pilot programme “Common Dissemination Booster” together with two other H2020 projects: SOLUS (Smart optical and ultrasound diagnostics of breast cancer, led by POLIMI) and PAMMOTH (Photoacoustic/Ultrasound Mammography for evaluating screening-detected abnormalities in the breast, led by the University of Twente). In the course of the last reporting period, the last two consultancy services were completed: Service 4 Dissemination Capacity Building and Service 5 Dissemination Campaign in Practice. As outcome of services 4 and 5, the representatives of the LUCA and SOLUS projects produced a joint policy brief on the application of devices combining ultrasound and photonics to improve cancer screening and diagnostics. The policy brief entitled “Protecting society through innovative technologies for cancer screening” is available on the [LUCA website](http://luca-project.eu/). It aims to raise awareness of the potential of photonics technologies to enhance screening accuracy and sets out a number of recommendations for strong policy formulation supporting the goals of improved screening and reducing costly unnecessary surgeries, and the promotion of innovation technologies for screening in the medical field and beyond:



- Recommendation #1: *Enhanced Non-Invasive Breast and Thyroid Cancer Screening Programmes*
- Recommendation #2: *Promotion of Innovative Photonics-based Technologies in Medicine and Beyond*
- Recommendation #3: *Improving the Time-to-Market for Innovative Photonics-based Technologies*

Moreover, LUCA continued to collaborate with the [VERTIGO project](#) and LUCA coordinator ICFP hosted an Artistic Residency. The VERTIGO project is a Coordination and Support Action supported by H2020, which promotes the arts for a creative conversion of science and technology knowledge into new products, services, and processes and funds artist residencies in R&D projects. As part of this programme, sound artist Reiko Yamada developed an artistic project called "Beyond Absolute" which is based on the results of the LUCA project. The main component of the project is the creation of personalized acousmatic soundscapes based on the data generated by the LUCA diagnostic device in conjunction with sonic alterations that represent the subjective mindset of the patients. During the artist's residency at ICFO, a [video](#) on her project was produced. Her project is featured on the LUCA website and related information was included in the LUCA newsletter.

3) Conclusion

Throughout the last project period, the LUCA partners remained actively involved in the dissemination of LUCA results. The consortium has successfully promoted the project, disseminated its results, and raised awareness of LUCA not only in the biomedical optics community but also in the medical and clinical communities and, particularly with the latest video targeting a non-expert audience and the collaboration with the art sector, also the general European public.