Fibre Optic Nonlinear Technologies [FONTE] - A European Industrial Doctorate [GA766115]

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Project Details

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Project Acronym	FONTE
Project Title	Fibre Optic Nonlinear Technologies
Call Identifier	H2020-MSCA-ITN-2017
Project Website	fonte.astonphotonics.uk
Start of the Project	1 June 2018
Project Duration	48 months

Consortium

Aston University

NOKIA Bell Labs

TELECOM ParisTech

TU Delft

DTU Technical University of Denmark

EC Funding

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 766115

Executive Summary

This deliverable details the **Scientific Research Output** of Project FONTE and dissemination measures taken in terms of peer-reviewed publications, conference papers and talks, public deliverables as well as less formal settings of dissemination via seminars and event posters. The main aim of these dissemination activities is to make the research conducted both freely available and easily discoverable.

Furthermore this deliverables summarised the host of **Public Engagement Activities** the consortium has been conducting, ranging from dedicated outreach activities lead by FONTE's early stage researchers to the project's presence on social media platforms and research networks, as well as covering posts, newsletters and ambassadorships. The main aim of these public engagement activities is to inform stakeholders and make research conducted in FONTE more accessible to all sectors of society.

This report covers the first 2 years of the 4-year FONTE European Industrial Doctorate (EC GA 766115).

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LIST OF ACRONYMS

AiPT	Aston Institute Of Photonic Technologies
EC	European Commission
EID	European Industrial Doctorates
ESR	Early Stage Researcher
FONTE	Fibre Optic Nonlinear Technologies

1 CONTEXT OF THE FONTE EID PROJECT

H2020 European Industrial Doctorate FONTE [Fibre Optic nonlinear Technologies] is a doctoral-level training network funded by the EC under Horizon2020 Marie Skłodowska-Curie ITN Action. The programme trains 4 Early-Stage Researchers (ESRs) and focuses on the development of disruptive nonlinear techniques and approaches to fibre-optic communications beyond the limits of current technology. The project will make important innovative steps in development of the technique of the nonlinear Fourier transform (NFT) and its implementation in the practical communication systems.

FONTE ESRs benefits from rich interactions between academia and industry, with a strong focus on industrial experience, exemplified by their 18 months secondment to world-leading ***Nokia Bell Labs (NBL)***, one of the largest and most recognised research organisations focusing on communications technology and conducting fundamental research in this field.

Furthermore, FONTE ESRs profit from a comprehensive training programme featuring inter-sectorial and multidisciplinary technical courses, which is complemented by a bespoke transferable skills training throughout their PhD.

This report details the **Scientific Project Output for the initial 24 months of the project** in form of peer-reviewed publications, conference talks and invited contributions as well as the project's public deliverables and other scientific communication in other less formal settings such as local seminars. Furthermore, this report summarised the **Public Engagement Activities** undertaken by the consortium members during the initial 24 months of the project, in particular outreach activities, social media interactions, blogs and websites maintained by ESRs and finally posts and newsletters published by the consortium.

2 SCIENTIFIC PROJECT OUTPUT

FONTE EID is a small project with 4 Early Stage Researchers (ESRs) and this is reflected by the research output. FONTE aims to have 16 journal papers and 12 conference papers attributed to its ESRs by the end of the project. All published research output is placed in local repositories and archives, such as **Aston Research Explorer** https://research.aston.ac.uk/, **TU Delft Research Information Portal** https://pure.tudelft.nl/portal/ , **DTU Orbit** https://orbit.dtu.dk/ and **ZENODO** https://zenodo.org/ to increase its visibility and make it discoverable. FONTE aims to have all its research output either gold or green **Open Access** by default.

2.1 PEER-REVIEWED JOURNAL PUBLICATIONS AND CONFERENCE PROCEEDINGS (NEWEST ON TOP)

2.1.1 Vinod Bajaj, S. Chimmalgi, V. Aref and S. Wahls
Exact NFDM Transmission in the Presence of Fiber-Loss
Journal of Lightwave Technology
Early access publication: 02 April 2020

2.1.2 Francesco Da Ros, S. M. Ranzini, H. Buelow and D. Zibar
Reservoir-computing based equalization with optical pre-processing for short-reach optical transmission
IEEE Journal of Selected Topics in Quantum Electronics, vol. 26, no. 5, pp. 1-12, Sept.-Oct. 2020, Art no. 7701912

2.1.3 **Vinod Bajaj, S. Chimmalgi, V. Aref and S. Wahls**
Exact nonlinear frequency division multiplexing in lossy fibers
Proc. 45th European Conference on Optical Communication (ECOC2019), Dublin, Ireland, Sep. 2019
(in press)

2.1.4 **Magalhaes Ranzini, S., Da Ros, F., and Zibar, D.**
Joint low-complexity opto-electronic chromatic dispersion compensation for short-reach transmission.. Proceedings of 2019 IEEE Photonics Conference IEEE. (San Antonio, United States, 29/09/2019
(in press)

Figure 1: FONTE ESRs at ECOC2019 conference

2.1.5 **Magalhaes Ranzini, S, Da Ros, F, Bülow, H and Zibar, D.**
Tunable Optoelectronic Chromatic Dispersion Compensation Based on Machine Learning for Short-Reach Transmission,
Applied Sciences, vol. 9, no. 20. https://doi.org/10.3390/app9204332
Published: 15 October 2019

2.2 PEER-REVIEWED CONFERENCE TALKS AND OTHER INVITED CONTRIBUTIONS

In addition to the dissemination activities below, several FONTE ESRs (SMR; VB; VN) are about to submit papers for consideration to the ECOC2020 conference (original deadline 20 May, now postponed due to COVID-19 to 28 August 2020) and International Photonics Conference 2020 (deadline 31 May 2020).

2.2.1 **Stenio M. Ranzini, F. Da Ros, H. Bülow, and D. Zibar**
Invited Presentation accepted to ICTON2020
Title: Optoelectronic signal processing for chromatic dispersion mitigation in direct detection systems
Bari, Italy; 19-23 July 2020
also to be published as Conference Proceedings [not yet available]

2.2.2 **Darko Zibar**
Short Course at Optical Networking and Communication Conference (OFC2020)
Title: Hands-on: Machine Learning in Optical Networks OFC2020
San Francisco, California, USA; 9 March 2020
(course CANCELLED due to COVID-19)

2.2.3 **Darko Zibar**
Invited workshop and Seminar at Nelson Mandela University
Title: *Machine Learning Techniques*
Port Elizabeth, Province of Eastern Cape, South Africa; 12-14 Feb 2020

2.2.4 **Darko Zibar**
Invited presentation at the 27th International Conference on Software, Telecommunications and Computer Networks (SoftCOM 2019)
Title: Machine Learning Techniques for Next-generation Optical Communication Systems
Split; Croatia; 19-21 September 2019

2.2.5 **Vinod Bajaj**
Oral presentation at the Nonlinear Fourier Transform Workshop (NFT2020)
Title: Exact NFDM Transmission in the Presence of Fiber-Loss
TU Delft, Delft, The Netherlands; 5 Feb 2020

2.2.6 **Francesco Da Ros, S. M. Ranzini, H. Bülow, and D. Zibar**
Invited presentation at conference Photonic Reservoir Computing and Information Processing in Complex Networks
Title: Neural Network based Hybrid Optical-Digital Equalization for Short-reach Transmission.
Trento; Italy; 4-6 December 2019

2.2.7 **Vinod Bajaj, S. Chimmalgi, V. Aref, Sander Wahls**
Oral presentation at 45th European Conference on Optical Communication ECOC2019
Title: Exact nonlinear frequency division multiplexing in lossy fibers
Dublin; Ireland; 22 – 26 September *2019*
also published as Conference Proceedings [see 2.1.3]

2.2.8 **Stenio M. Ranzini, F. Da Ros, D. Zibar**
Oral presentation at IEEE Photonics Conference
Title: Joint low-complexity opto-electronic chromatic dispersion compensation for short-reach transmission.
San Antonio, TX USA; 29 Sept to 3 Oct 2019
also published as Conference Proceedings [see 2.1.4]

2.3 PUBLIC SCIENTIFIC DELIVERABLES

The following deliverables (newest on top) have been submitted the European Commission via the Funding and Tender Portal, and have simultaneously been made public and Open Access on the Project website at https://fonte.astonphotonics.uk/deliverables-public/

- D1.2 New modulation techniques for NFT systems (30 May 2020)
- D1.3 Numerical verification advanced modulation techniques
- D2.3 Numerical and experimental validation of the robust modulation formats
- D3.3 Performance analysis of monitoring techniques based on machine learning (14 May 2020)
- D4.2 Multi-user communication and information theory (26 Mar 2020)
- D5.1 Transmission regime definition and plan of experiments (24 Dec 2019)
- D1.1 Review and optimization results for the NIS NFT-based systems (21 Nov 2019)
- D4.1 Principles of linear and nonlinear frequency-division multiplexing (30 Sept 2019)
- D2.2 Software implementations of the developed robust NFT algorithm (05 Aug 2019)
- D3.2 System identification and parameter estimation (22 May 2019)
- D2.1 Report on major impairments in NFT-based transmission (27 Mar 2019)

- D3.1 Survey of machine learning algorithms for optical performance monitoring (21Jan 2019)

2.4 SCIENTIFIC POSTERS AT EVENTS (NOT PEER-REVIEWED)

Several posters about FONTE research results have been presented at international conferences and workshops (newest on top):

- **Stenio M. Ranzini;** F. Da Ros; H. Bülow; D. Zibar
  Poster at Workshop on Next-Generation Cloud Infrastructure at Microsoft Cambridge
  Title: Tunable optoelectronic chromatic dispersion compensation based on machine learning for short-reach transmission
  Cambridge, UK; 25 Nov. - 26 Nov. 2019
- **Vinod Bajaj**, S. Chimmalgi, V. Aref, S. Wahls
  Poster at NOKIA Bell Labs' Students Day 2019
  Title: Exact NFDM in Lossy Fibers
  Stuttgart, Germany; 25 Nov 2019
- **Stenio M. Ranzini**, F. Da Ros, H. Bülow, D. Zibar
  Poster at 10th Optoelectronics and *Photonics Winter School (NLP209)*
  Title: Optical Neural Network and Reservoir Computing for Optical Fiber Communications
  Adeno, Italy; 20 Jan. - 26 Jan. 2019

2.5 INFORMAL SEMINARS AND TALKS

All ESRs regularly present their progress and latest results at *in-house* seminars at their local host and secondment institutions.

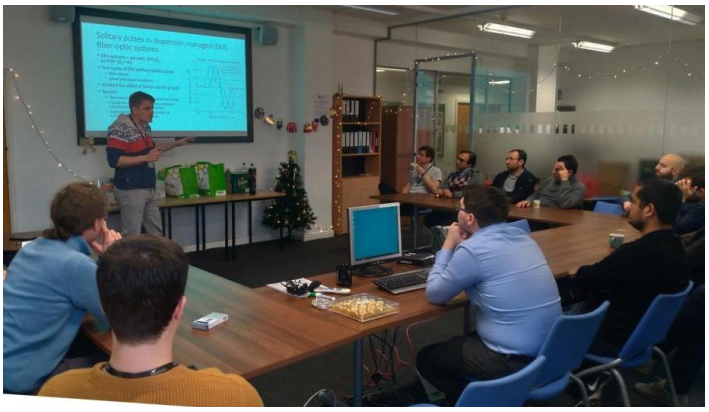


Figure 2: ESR1 presenting his research during group seminar at Aston University

3 PUBLIC ENGAGEMENT

Outreach and public engagement activities are meant to engage a large audience and to bring knowledge and expertise on a particular topic to the general public. The objective of outreach is to explain the benefits of research to a larger public (the tax payers who fund the research). Outreach is not a one-way communication from the scientist to the audience, but an engaging and interactive two-way communication between the researcher and the public.

Considerations regarding the target audience and the aim of the activity influence the choice of outreach activities. Working with schools connects young people with contemporary research and using unfamiliar and specialist scientific equipment can excite pupils and helps to inspire the next generation of researchers. [1]

A far larger and dispersed potential audience can be reached through the internet, connecting to people across the world to talk about FONTE research. FONTE, its senior scientists and all ESRs engage with the

[1] https://ec.europa.eu/research/mariecurieactions/resources/document-libraries/guidelines-your-outreach-activities_en

public through social media such as Twitter, Blogs, youtube and private websites, as well as professional social networks, such as LinkedIn and Research Gate.

Some of these interactions are taking advantage of the international nature of FONTE where ESRs are capable to converse in more than just one language. Thus, between them, FONTE ESRs engage with the public in bi-lingual blogs and websites featuring **English, French and Russian**.

3.1 OUTREACH ACTIVITIES DURING THE INITIAL 24 M OF THE PROJECT

3.1.1 ESR1 at **PhotonEx EUROPE 2019**: Outreach to international SMEs and Industry

Figure 3: ESR1 at PhotonEx 2019

FONTEs **ESR1 Vladislav** was part of the Aston team at Photonex Europe 2019 (9—10 October 2019; Coventry, UK), one of the UK's premier events dedicated to photonics, imaging, lasers and optical technologies from pure research to development of bespoke advanced user solutions. This annual 2-day event in Coventry presented an important opportunity for AiPT to reach out to industry and disseminate its research.

In 2019 AiPT was represented at Photonex 2019 with a dedicated booth, manned by 5 members of AiPT (including **FONTE ESR1**) and well stocked with posters and flyers showcasing the latest research at the **Aston Institute of Photonic Technologie**s. The looped background presentation and multitude of information material gave ample talking points to visitors at the booth.

Vladislav took full advantage of the exposure and spoke at length to various industrial leaders, such as the representative from IPG Photonics, a global leading developer and manufacturer of high-performance fiber lasers, giving our ESR the opportunity to discuss his research at length.

3.1.2 ESR3 at **Copenhagen Culture Night**: Outreach to Danish General Public

Figure 4: ESR3 at Copenhagen's Culture Night 2019

On 11 Oct 2019 **FONTE ESR3 Stenio** was involved in a **major public outreach event** at DTU and across Copenhagen. ***'Cultural Night/ Kulturnatten***' (https://www.kulturnatten.dk/en/Culture-night) is one of Copenhagen's most attended cultural events, and with over **69.000** visitors in 2019 **Culture Night** has the potential to reach a very large audience of local families**.** More than 250 museums, theatres, libraries, churches, ministries, and parks throughout the city welcome the public during **Copenhagen's biggest annual one-day event**.

Stenio present an overview of optical communication to the general public, a topic closely related to his PhD research. He attended the event as part of DTU's **SPOC group** (http://www.spoc.dtu.dk/ . It was a busy and

stimulating night with a lot of people interested in the basic concept of optical communication to understand how all the information is connected in our world.

3.1.3 ESR3 at **DTU Project Day**: Outreach to Danish High School pupils in Copenhagen

On 25 Oct 2019 **FONTE ESR3 Stenio** participated in **DTU's Project Day** (https://www.fotonik.dtu.dk/english/education-ny/dtu-project-day-2019), representing the ***Machine Learning in Photonic Systems*** group. Speaking to a mixed audience of mainly high school student from different local schools and backgrounds, Stenio was able to explain his research to an interested audience.

Figure 5: ESR3 at DTU Project Day with high school pupils

3.1.4 ESR2 at **Nokia Bell Labs' Student Day**: Outreach to German High School pupils

On 25th November 2019 **FONTE ESR Vinod** participated in the ***Bell Labs Students' Day***, one of three annual outreach and dissemination ***NOKIA student's Days*** organised by FONTE's industrial Partner Nokia Bell Labs, Stuttgart.

Nokia Students' Days are special customized for all students, who are interested to see the real life in one of the most renowned research institutions of the world, the **Nokia Bell Labs**.

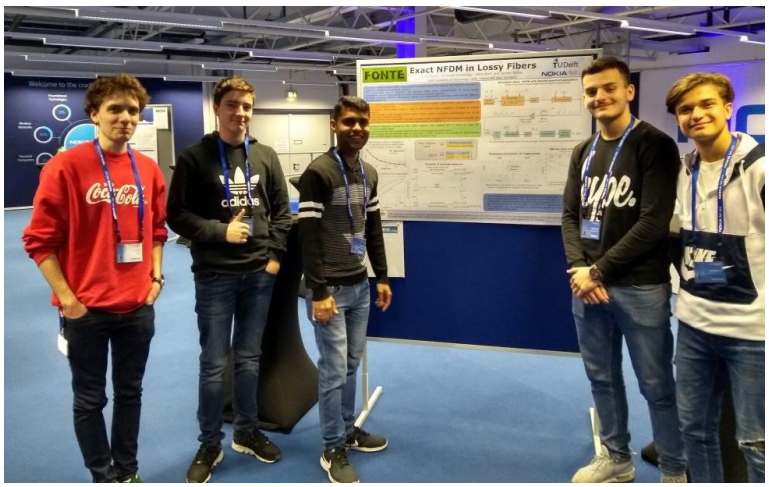


Figure 6: ESR2 at NOKIA Bell Labs Student Day with high school students

Visitors were able to engage with Bell Labs Researchers at their demos and posters in the exhibition and discuss aspects of their research, as well as listen to talks from prestigious research leaders. Those interested in a computational challenge were able to participate in the Nokia Bell Labs Hackathon, this year focussing on the general area of 5G, server-less and Edge Cloud Computing.

The event attracted about 50 university and school students in addition at an equal number of visitors from academia and Nokia Bell Labs, bringing the total number of attendees to up to 100.

In the morning FONTE's ESR **Vinod** presented his research to other PhDs and researchers from Nokia Bell Labs, after which the posters were critically reviewed by senior tech-leaders from Nokia Bell labs. In afternoon local high school students visited the event. Vinod discussed their understanding of the infrastructure underlying the internet and the nature and advantages of optical fibres, leading seamlessly into a broader debate about research in the telecom field.

3.1.5 ESR1 at School's **Careers Fair**: Outreach to British Elementary School pupils

Figure 7: ESR1 at Primary/Elementary school students

On 14 Feb 2020 **FONTE ESR1 Vladislav**, together with Aleksandr Donodin (ESR in WON-ETN (https://won.astonphotonics.uk) and Payal Baheti, spend a day at a **Birmingham Primary School** with children aged 10-11. During the school's '**Career's Fair and Science Day**' Vlad, Sasha and Payel were able to demonstrate optical phenomena and run simple hands-on optics demos, all the while chatting to the school children about what it is like to be a scientist at university, proving to them that working in Physics, Technology and Engineering does not have to be boring but is '*rather cool*' instead.

3.1.6 Outreach to international ERASMUS MUNDUS students

Engagement activities include not only FONTE ESRs, but also their Project Manager, who on 24 Feb 2020 lead an **Outreach Activity** in Birmingham,UK aimed at international student in the photonics-related ERASMUS MUNDUS JOINT MASTERS DEGREE (EMJMD) programmes coordinated by AiPT: **SMARTNET** and **PIXNET**.

Figure 8: FONTE Project Manager with EMJMD students of SMARTNET and PIXNET

As both programmes train EMJMD students in photonics and communication technologies, this presented an opportunity to discuss post-MSc options with programme students, and in particular introduce them to the **Marie Skłodowska-Curie Actions (MSCA)**. The outreach session focussed on the unique opportunities available within ***Innovative Training Networks in MSCA – European Training Network/European Industrial Doctorate and European Joint Doctorate*** –, introduced concepts of mobility and eligibility and contrasted the working conditions, enhanced training framework and obligations towards outreach within MSCA with those of other, more 'usual' PhD pathways. The students were familiarised with **EURAXESS** as an efficient tool to discover research positions available under MSCA.

3.1.7 Upcoming: **CityFest Urban Futures**: Outreach to the British General Public

A major Birmingham-wide Outreach Event '***CityFest Urban Futures'*** is planned for 8th July 2020 with participation of all FONTE ESRs. Following in the footsteps of LightFest, this event is due to take place at the Birmingham Museum & Art Gallery. Unfortunately due to current COVID-19 travel restrictions and social distancing guidelines, this event is currently under revision and unlikely to go ahead as planned in July. It is anticipated that the event will be postponed to a later date.

Figure 9: CityFest – a major outreach event planned in Birmingham, UK

3.2 SOCIAL MEDIA ACTIVITIES

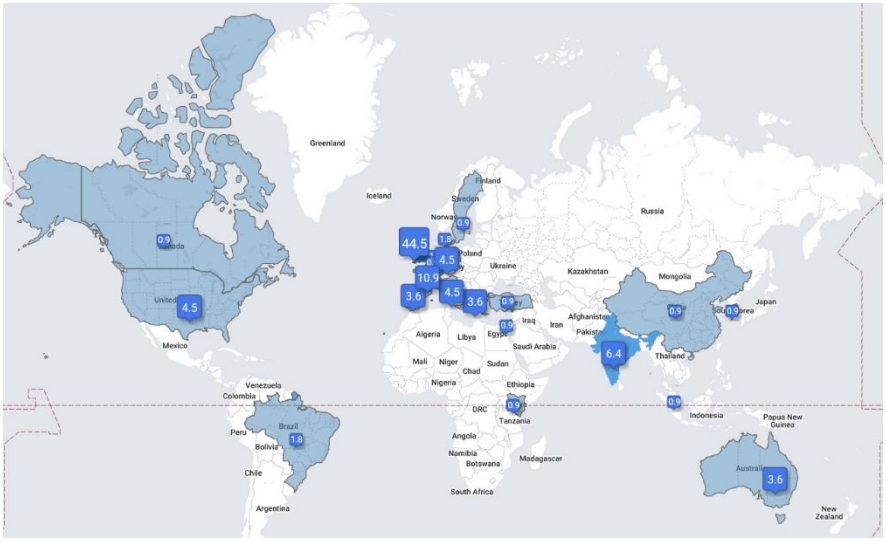
FONTE engages in **several languages** with an international audience via different social media feeds, such as twitter, blogs ESR's own project-related websites, Research Gate, LinkedIn etc. These are described in more detail below.

3.2.1 Twitter

FONTE's main Twitter feed is located at https://twitter.com/EidFonte

The twitter feed is populated at least weekly with FONTE output, activities or training events, details of upcoming conferences, webinars etc. as well as relevant retweets from other sources.

The account is currently followed by 122 photonics-related individuals, research groups and companies from 21 countries in 6 continents.



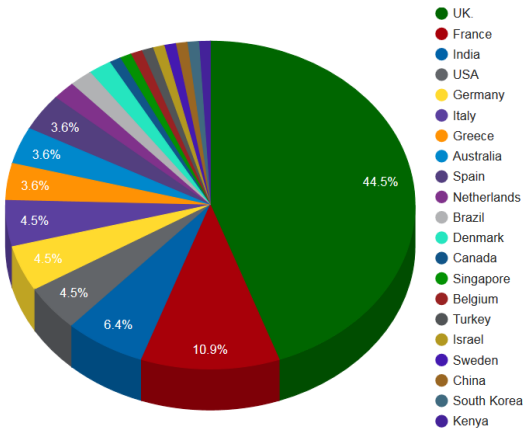


Figure 10: Geographic reach of FONTE's Twitter feed

Figure 11: Influential followers of FONTE's Twitter feed

FONTE has worked tirelessly to build its follower base on twitter https://twitter.com/EidFonte. Among influential followers we count the **Editor of Nature Photonics Dr Rachel Won** (2.1K followers), several research labs, such as CEMES-CNRS (6.6K+ followers); Recherche_ECLyon (3.6K followers); Eggleton Lab at University of Sydney (700+ followers); Armani Lab at USC (700+ followers), commercial companies, such as American Elements, a Nanotech company with 32.3K followers, scientific output channels such as Photonics Online Meetup, pioneers in online conferences with 1.4K+ followers, Nanophotonics (a journal with 1400+ followers); Institute of Physics (700+ followers); and influential individuals such as (Professors) Paolo Biagioni (900+), Alexandra Boltasseva (1.3K), Salahuddin Nur (600+).

FONTE members also tweet individually about their science output (among other topics):

- Coordinator Sergei Turitsyn: @im_sergei / https://twitter.com/im_sergei
- WP Leader Darko Zibar: @DarkoZibar14 / https://twitter.com/DarkoZibar14
- WP Leader Sander Wahls: @SanderWahls / https://twitter.com/SanderWahls
- ESR1 Vladislav Neskorniuk: @VNeskorniuk / https://twitter.com/VNeskorniuk
- ESR2 Vinod Bajaj: @I_am_VinodBajaj / https://twitter.com/I_am_VinodBajaj
- ESR3 Stenio Ranzini: @stenio_ranzini / https://twitter.com/stenio_ranzini
- ESR4 Abtin Shakarami: @AbtinShahkarami / https://twitter.com/AbtinShahkarami

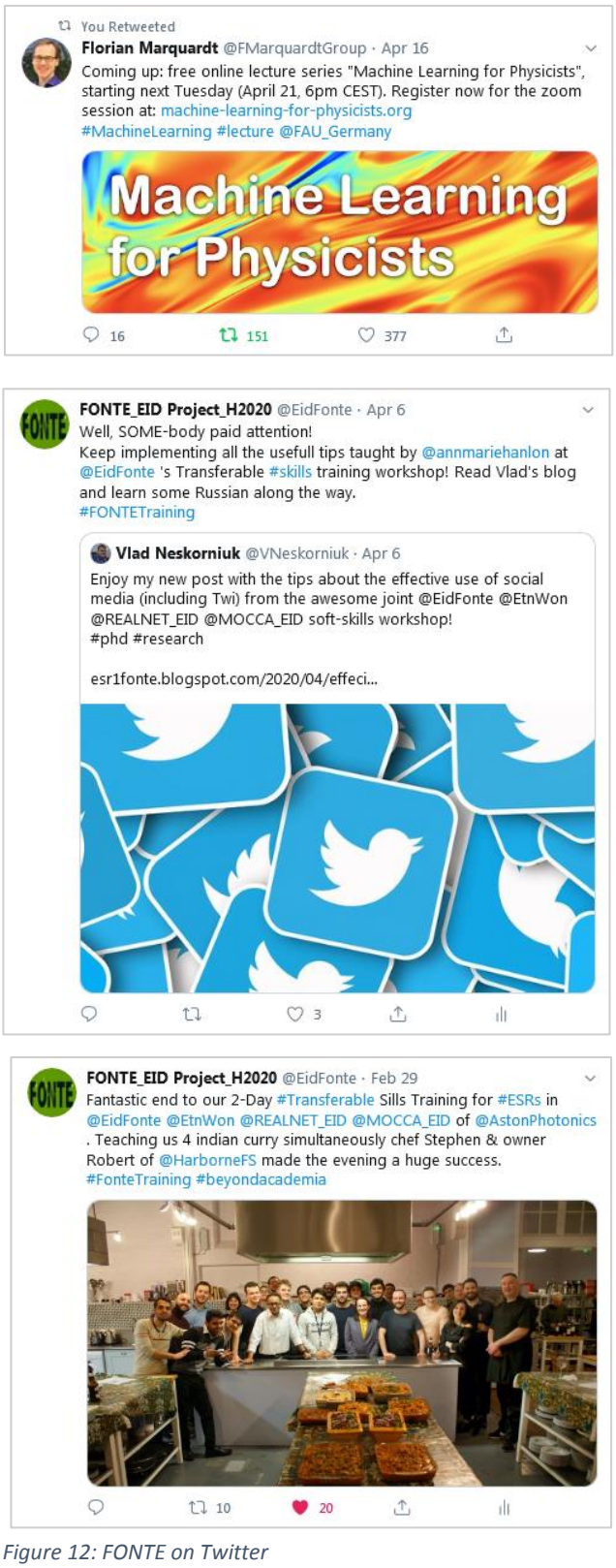


Figure 12: FONTE on Twitter

3.2.3 Blogs, Videos and FONTE-related personal websites

All FONTE ESRs have their own blogspot, where they post longer pieces of entertaining or reflective general interest, detailing their experience in the MSCA training network. These social media blogs complement the twitter feeds and appear directly on the FONTE website. Vlad (ESR1) is blogging bilingually in both English and Russian.

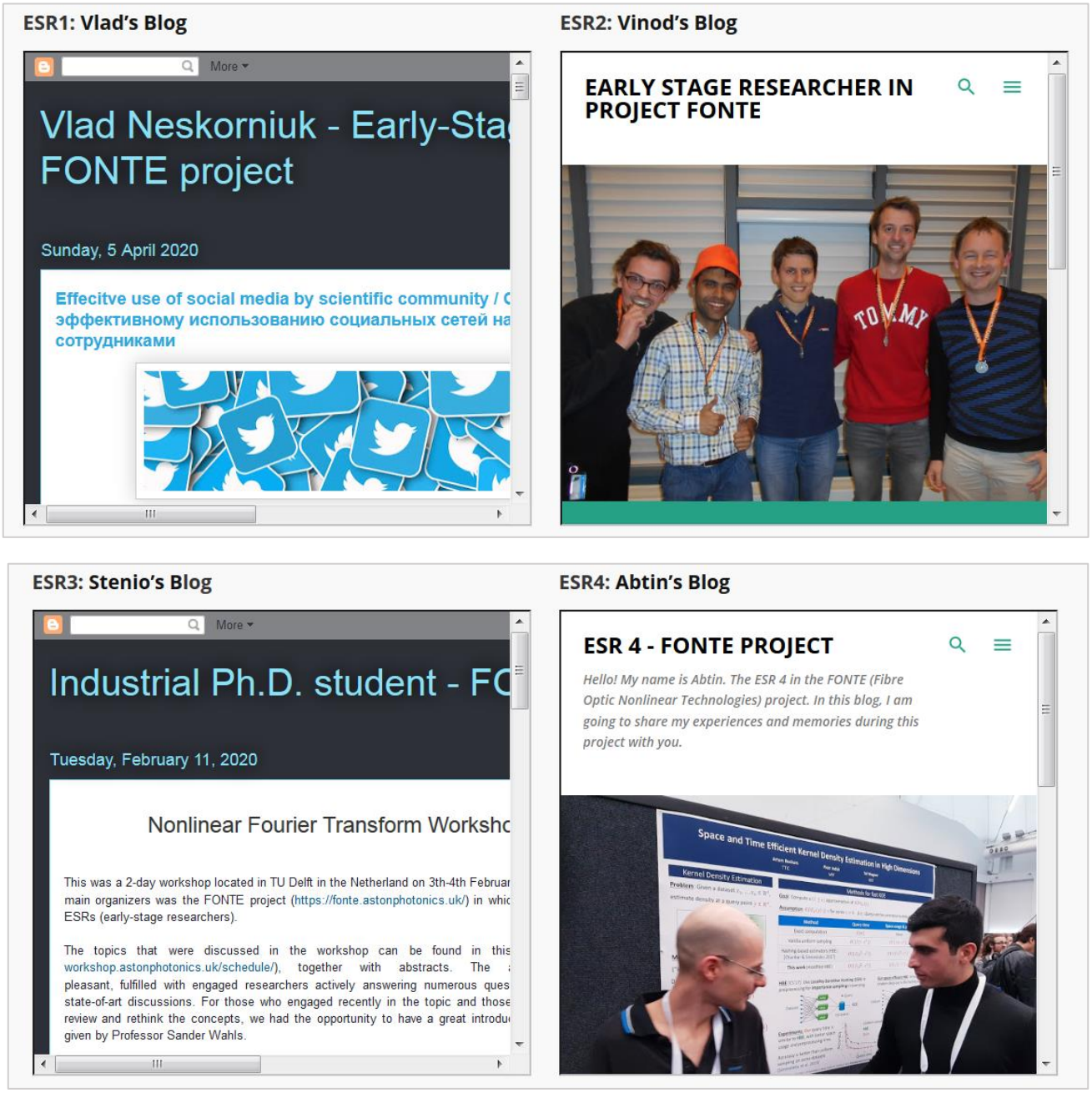


Figure 13: Blogs by FONTE's ESRs

In addition, Abtin (ESR4) has recently created his own stand-alone bilingual website to communicate his own research interests to the wider public. His first article is a general-interest piece on ***'How will artificial intelligence make a better world?'***. He is planning to write a series of articles (in French) and to record a series of video programs (in English) on the issue of and 'Artificial Intelligence' and 'AI and Industry'.

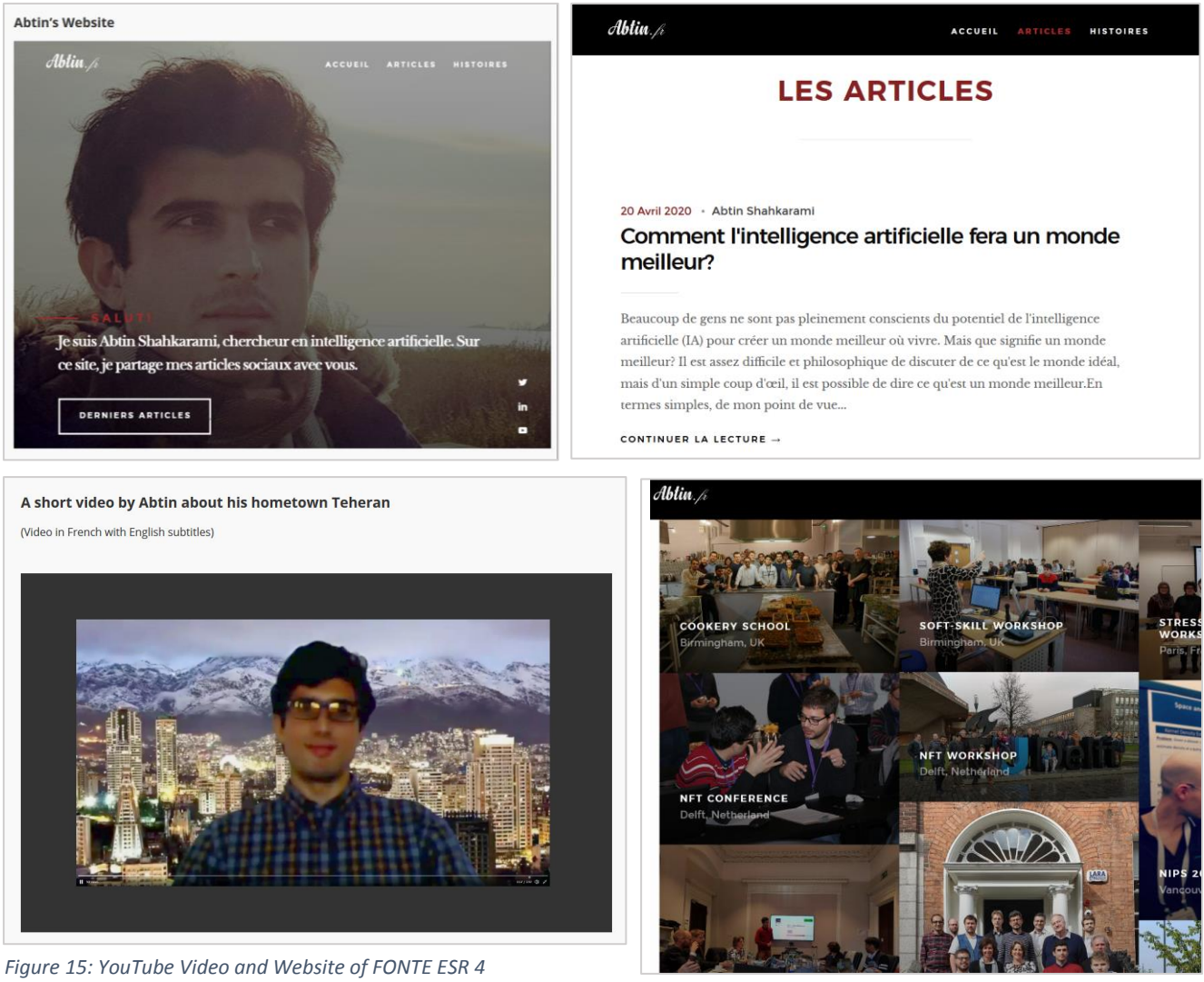


Figure 15: YouTube Video and Website of FONTE ESR 4

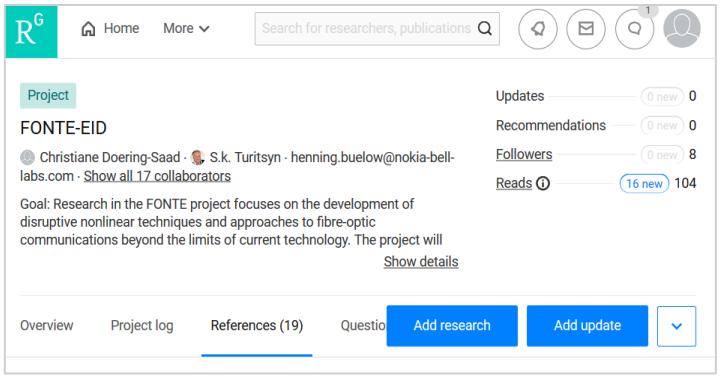


Figure 14: The FONTE Project page on Research Gate

3.3 Research Gate, Orcid and LinkedIn

As one of the many means to share project research output, Fonte-EID also has a presence on the scientific online platform ***Research Gate*** at https://www.researchgate.net/project/FONTE-EID. In addition, all ESRs have individual ***LinkendIn*** accounts and ***ORCID*** to further widen the reach of their scientific output and make it easily discoverable.

3.4 MEMBERSHIPS AND AMBASSADORSHIPS

Several of the FONTE ESRs are members of the local **OSA SPIE student chapters** and participate in periodic engagement activities. For example, the **Aston OSA SPIE student chapte**r has organised an interactive workshop devoted to Machine Learning algorithms and neural networks. ESR1 is **STEM Ambassadors** for Science Technology Engineering and Mathematics at Aston University, while other FONTE ESRs are **Student Ambassadors** for their local universities, where they participate in activities such as open days.

3.5 POSTS AND NEWSLETTERS

Blogs on the FONTE website are another way of engaging with both research community and the wider public. Posts are published frequently on a range of topics, covering activities of the ESRs within FONTE, Awards and recognitions received, papers published, interesting and topical pieces from other outlets etc. FONTE also publishes periodic newsletters, drawing together the activities and news across the consortium from the previous 6-months period.

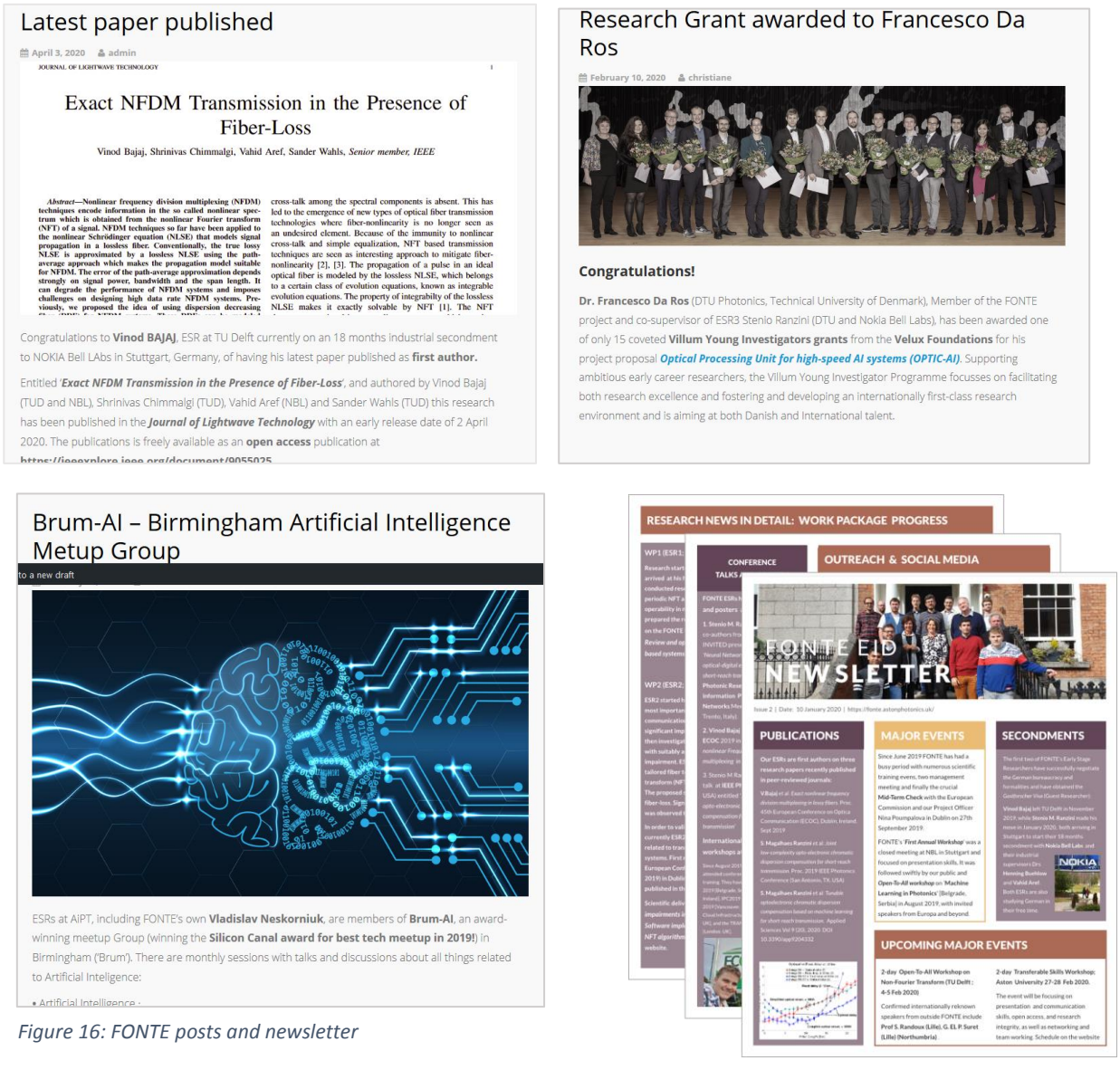


Figure 16: FONTE posts and newsletter

3.6 SUMMARY OF OTHER ENGAGEMENT ACTIVITIES WITH THEIR AUDIENCE AND REACH

Date	Event	Location	Details	Audieince	Size of audience
09-Mar-20	Invited Presentation	San Diego, USA	Francesco Da Ros (standing in for Darko Zibar, WP leader) delivers an invited presentation at the Optical Networking and Communication Conference (OFC2020) entitled 'The Role of Machine Learning for the Next-generation of Optical Communication Systems and Networks'	OFC Conference Attendees	8000 (down from 15,000 due to COVID-19)
09-Mar-20	Short Course	San Diego, USA	WP Leader Darko Zibar delivers a course at the Optical Networking and Communication Conference (OFC2020) entitled 'Hands-on: Machine Learning in Optical Networks' (Note: event cancelled due to COVID-19)	OFC Conference Attendees	8000 (down from 15,000 due to COVID-19)
01-Jan-20	Newletter produced	online	FONTE Newsletter Issue 2 produced and uploaded onto FONTE website	general public	
14-Jan-20	Seminar at Microsoft Research Labs	Cambridge, UK	WP Leader Darko Zibar delivered a seminar at Microsoft Research Lab (Cambridge) entitled 'Advancing classical and quantum communication systems using machine learning'	Researchers in Industry	about 20
13-Jan-20	Seminar at Cambridge University	Cambridge, UK	WP Leader Darko Zibar delivered a seminar at Cambridge University entitled 'Advancing classical and quantum communication systems using machine learning'	Academics, graduate and postgraduate studens	about 35
05-Dec-19	2019 Annual Research Conference at AiPT	Birmingham, UK	Presentation and poster at the 2019 AiPT Annual Research Celebration	Resarchers in the field of Photonics	150
05-Dec-19	Seminar at SPIE Student Chapter	Birmingham, UK	ESR Vadislav Neskornium gave a seminar at the Aston SPIE Student Chapter about his research	Resarchers, PhD students and Post Docs in the field of Photonics	15
25-26 Nov 2019	2019 Microsoft Research Cambridge PhD student Workshop on Next Generation Cloud infrastructure	Cambridge, UK	ESR Stenio M. Ranzini has participated in the Microsoft Workshop on Next Generation Cloud Infrastructure , where he was able to present his work to a cross-diciplinary team of Microsoft researchers and discuss the future of the cloud. The event was by invitation only!	Microsoft researchers and PhD researchers	60
25-Nov-19	2019 NBL Innovation Day	Stuttgart, Germany	ESR Vinod BAJAJ participated in the annual Innovation Day at Nokia Bell LAbs, presenting a poster with his research findings and speaking to visitors to the event. Read full post here	Local High School Students, teachers, undergraduate and postgraduate students	about 100
9-10 Oct 2019	Photonex Europe 2019	Coventry, UK	FONTE was present at Photonex 2019 , a major UK conference and trade exhibition, where project FONTE is represented in the AiPT booth by the Aston University's ERS1 Vladislav Neskorniuk who had a slide show and talked about his research .	Researchers & engineers from industry & academia. Presence of over 90 SMEs and companies	1,100

18-20 Sept 2019	Optical Solitons and Frequency Comb Generation 2019	Berlin, Germany	FONTE Coordinator Prof. S. Turitsyn invited speaker at this important conference and networking event, speaking to colleagues about FONTE	Scientists	30-35
Sep-19	Brochure 'AiPT Educational Programmes 2019-20'	Birmingham, UK	Produced a Brochure about Educational programmes at AiPT, including project FONTE	Scientists; graduate and undergraduate students	500 copies printed plus digital distribution
July/Aug 2019	ErasmusPlus Staff Exchange involving FONTE	Kiev, Ukraine	Yaroslav Prylepskiy, FONTE WP1 leader and supervisor, spearheads the organisation of an ErasmusPlus Staff Exchange Programme involving the National Technical University of Ukraine – Kyiv Polytechnic Institutey, one of the most prestigious institutions in the Ukraine. One of the aim of this exchange is disseminating FONTE project details, enriching research and collaboration ties, and delivering lectures & seminars to FONTE ESRs.	Ukranian Scientists	small
23-27 Jun 2019	CLEO EUROPE 2019	Munich, Germany	Produced a Poster and Banner about AiPT ITNs including FONTE for booth at CLEO Munich 2019 Conference .	Scientists; companies	3,800
31-May-19	Newsletter produced	Online	FONTE Newlsetter Issue 1 produced and uploaded onto website	general public	
May-19	Research Gate	online	A FONTE Project Page was encoded on this social networking site for scientists and researchers)	Scientists	15 Mill users of site
May-19	Brochure:' Research at AiPT'	Birmingham, UK	Produced a Brochure about Research at AiPT , including project FONTE.	Scientists	500 copies produced plus digital distribution
3-7 Mar 2019	Optical Fiber Communication Conference OFC 2019	San Diego, USA	Produced and distributed a Flyer about FONTE at OFC 2019 and other conferences.	Scientists; companies	15,400
01-Oct-19	Brochure 'AIPT Educational Programmes 2019-20'	online and printed brochure	Produced a Brochure detailing Educational Programmes and postgraduate opportunities at AiPT including project FONTE	Undergraduate and MSc students; scientists and Research Group leaders	1000 copies printed plus digital distribution