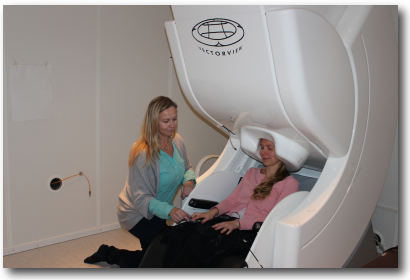
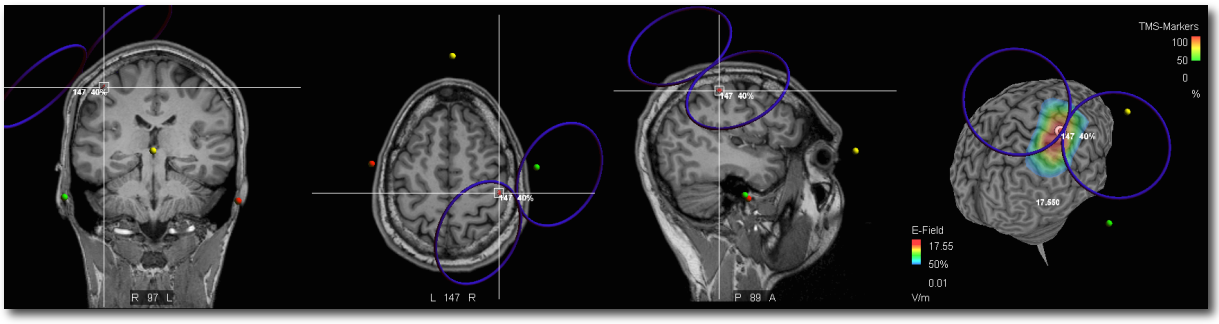
ANNUAL REPORT OF

AALTO NEUROIMAGING

AALTO UNIVERSITY SCHOOL OF SCIENCE

2014





Composed by Toni Auranen, Veikko Jousmäki, and Mikko Nyrhinen

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Director's executive summary

The second year of Aalto NeuroImaging (ANI) infrastructure at Aalto University School of Science is past and it is time to collect the achievements. Scientifically, the year 2014 was a success with 33 publications in top-quality scientific journals. The roadmap positions in the European Strategy Forum on research Infrastructures (ESFRI), the Finnish Research Infrastructure (FIRI) of the Academy of Finland, and the Finnish participation in the Euro-BioImaging (EuBI) ESFRI Initiative to strengthen imaging infrastructures in Europe are evolving. The related contributions by Professor John Eriksson at Åbo Academy and Academy Professor Riitta Salmelin at Aalto University are highly acknowledged.

Financially, the year 2014 was close to the previous year. The ANI budget depicts that the costs were covered in 2014 by user fees. It makes a solid foundation to maintain and develop the ANI infrastructure.

In 2014, ANI received a major financial support, 40% of the budget, from the Aalto University School of Science Dean Risto Nieminen. The support was used mainly to reduce the fees of the users from the Aalto University and NEUROIMAGING infrastructure. Hopefully, the financial support will continue in the future since it is a very important support to research and education at the Aalto University.

AMI Centre gained the all-time record in the measurement hours used and it is the crown jewel of the ANI infrastructure when it comes to number of internal users, external users, and publications. MEG Core usage rate was lower compared with the previous year due to a few large projects that ceased in 2014. Nevertheless, the MEG Core has a strong contribution in the MEG world. Aalto TMS is still in take-off phase and the usage level is increasing gradually. All three units of the ANI infrastructure have organized multiple user trainings to attract potential new users.

I would like to express my gratitude to ANI users and employees. Your scientific output and support work have been very important and valuable both for the neuroscience community and infrastructure. Together we stand, divided we fall.

The year 2015 will be another year of changes. The reorganizational changes at Aalto University School of Science has resulted in the new Department of Neuroscience and Biomedical Engineering (NBE) starting from January 1st, 2015. Hopefully, the synergy within the new department will increase the use of the ANI infrastructure and result in increased number of scientific results.

Magnetically yours,
Veikko Jousmäki

1 Introduction

Aalto NeuroImaging (ANI) research infrastructure was established on January 1st, 2013 at Aalto University School of Science (SCI). ANI research infrastructure houses three functional neuroimaging modalities, navigated and repetitive transcranial magnetic stimulation (nTMS and rTMS) at Aalto TMS laboratory, functional magnetic resonance imaging (fMRI) at Advanced Magnetic Imaging (AMI) Centre, and magnetoencephalography (MEG) at MEG Core. Until the end of 2014, ANI was administrated by Brain Research Unit (BRU) at O.V. Lounasmaa Laboratory (OVLL), Aalto University School of Science. From the beginning of 2015, BRU part of OVLL and Department of Biomedical Engineering and Computational Science (BECS) formed a new department – Department of Neuroscience and Biomedical Engineering (NBE) – which will be the new administrative host of ANI starting from 2015. Both AMI Centre and MEG Core are well established and have a long history and tradition starting from the Helsinki University of Technology whereas Aalto TMS was started in 2013. Docent Veikko Jousmäki from the BRU has been the ANI director since February 1st, 2013.

ANI is part of NEUROIMAGING research infrastructure administrated by Aalto University together with University of Helsinki (UH) and Hospital District of Helsinki and Uusimaa (HUS, Helsingin ja Uudenmaan sairaahoitopiirin kuntayhtymä) in the capital region. NEUROIMAGING (started in 2011), is based on agreement between AU, UH, and HUS, and covers, in addition to Aalto TMS, AMI Centre, and MEG Core in the Otaniemi campus, also the BioMag Laboratory located at the Meilahti hospital. The goal of the NEUROIMAGING agreement, in brief, is to enhance joint use and development of the large-scale brain imaging facilities. ANI and NEUROIMAGING, were granted with recognition on "Finland's strategy and roadmap for research infrastructures 2014–2020" (2014) by the Academy of Finland and Ministry of Education and Culture. ANI and NEUROIMAGING are also actively involved in establishing the Finnish Infrastructures for Functional Imaging (FIFI) consortium. FIFI is a national-level large-scale infrastructure providing open access services in functional *in vivo* imaging of humans and animals. FIFI aims to guarantee that cutting-edge imaging technology is widely available for research and development projects both in academia and industry to enhance the science and to exploit the biomedical imaging infrastructures to the fullest. FIFI partners serve more than 700 users annually.

The NEUROIMAGING Steering Board comprised two members from the Aalto University (Dean Risto Nieminen, Academy Professor Riitta Salmelin), two from the UH (Professor Kimmo Alho, Professor Timo Erkinjuntti whose acting deputies have been Professors Teija M. Kujala and Pentti Tienari, respectively), and two from HUS (Director Pekka Tervahartiala, Chief Physician Erika Kirveskari). The Directors of the units act as experts with the right to speak in Steering Board meetings (ANI: Director Veikko Jousmäki, DrTech Toni Auranen; BioMag: Director Jyrki Mäkelä, DrTech Juha Montonen). The Steering Board had four meetings in 2014; the appointed chairman of the Steering Board for the first three-year period (2014–2016) is Dean Risto Nieminen and the secretary in 2014 was DrTech Toni Auranen. Academy Professor Riitta Salmelin has also played a vital role in the FIFI consortium coordination.

Aalto NeuroImaging infrastructure brings new possibilities and openings for the brain research community. Our aim is to maintain and develop the best possible infrastructure for functional brain imaging. In 2014, we introduced a new reservation system, anitime.aalto.fi, for our facilities. All our units have their own budget and they are open for brain research community and other users. We have fixed user fees, our budget is transparent, and we meet the requirements set by the Academy of Finland, Tekes – the Finnish Funding Agency for Innovation, and European Research Council. We are strongly supporting neuroscience, one of the research focus areas of the Aalto University, aivoAALTO

(ended in 2014), and Aalto Brain Centre (started in 2014), Aalto University's initiative in neuroscience and neurotechnology.

More information is available at the following URLs:

- ani.aalto.fi
- neuroimaging.fi
- www.biomag.hus.fi

1.1 Aalto TMS

Aalto TMS laboratory was inaugurated in early 2013. It offers researchers unique possibilities for multi-modal neuroimaging techniques. The laboratory contains top-of-the-line navigated transcranial magnetic stimulation (nTMS) and electroencephalography (EEG) systems.

nTMS -system with two stimulation units (Bistim^2 and Super Rapid^2 Plus^1, Magstim Company Ltd., United Kingdom) and various coils makes numerous TMS and rTMS examination setups possible. Bistim^2 consists of two Magstim 200 units with a connection module making it possible to deliver paired pulses or one high-energy pulse in to a single stimulation coil. Connection module can also be disconnected making it possible to use two Magstim 200 units as separate stimulation devices. For this purpose the laboratory has two 70 mm figure of eight coils making dual-site stimulations with the system possible. Also new neuronavigation software (Visor2) version has a support for dual coil navigation. Super Rapid^2 Plus^1 consists of three power supply units, which enable high power/frequency stimulations. 70-mm air-cooled figure-of-eight coil makes high power/frequency scenarios possible without having to change the coil during or between sessions. With the two stimulation systems together, it is possible to do even triple-site stimulations in the Aalto TMS laboratory.

In addition, the 64-channel EEG-system with 16 EMG channels (NeurOne, Mega Electronics Ltd., Kuopio, Finland), specially designed for co-registration with TMS, can be used to map stimulus event-related responses simultaneously. The laboratory also contains a dedicated system for audio and visual studies with Matlab, E-Prime, and Presentation software available for stimulus delivery.

Aalto TMS has been designed to maximize user and test subject comfort. For example, there are four 42" LCD screens for neuronavigation, ceiling-mounted arm for the navigation camera, an adjustable table and chair for visual stimulation system and a headrest for test subject head support.

In 2014 Aalto TMS and AMI Centre started building a setup that enables concurrent transcranial magnetic stimulations and functional magnetic resonance imaging (fMRI). Furthermore, to promote TMS and TMS-fMRI research in Aalto University, Aalto Brain Centre (ABC) and Aalto NeuroImaging organized an event titled "TMS-fMRI Workshop 2014".

Total number of billed hours in 2014 was 120.5, which were slightly better than in 2013, but there is still much to improve for the next year.

1.2 AMI Centre

AMI Centre houses a research-dedicated, modern 3T Siemens Skyra (Siemens Healthcare, Erlangen, Germany) magnetic resonance imaging (MRI) scanner (installed in 2011). For more than ten years, several research teams from Aalto University, University of Helsinki (UH), Helsinki and Uusimaa Hospital District (HUS), as well as others (other academic users and industry) have used the facilities of AMI Centre for research and education. Since it's inauguration, AMI Centre has operated smoothly with only a few notable interruptions of use, such as major system upgrades of our old 3T MRI scanner (SIGNA^{TM} GE Healthcare Ltd.) in 2004 (Excite) and 2009 (HDxt), as well as the three month downtime in 2011, when the Skyra system was installed along with modifications of

preparation/waiting areas for the user groups.

The scanner houses 48 independent measurement channels, and since the purchase of our latest imaging coil, our users have had three distinct head coil arrays to choose from according to their needs; 32-channel head coil for excellent signal-to-noise ratio, a slightly more spacious 20-ch head-neck coil to be used with simultaneous EEG recordings, for example, and a custom-made modified version of the 32-channel head coil for excellent visual field of view for the volunteer. In 2014, we acquired the Siemens TimTX TrueShape and syngo ZOOMit –update enabling the latest possibilities in parallel transmission in MRI and fMRI as well as started the full use of our new Full HD Panasonic 3-DLP projector (PT-DZ110XE) with a custom made lens system for visual stimulation. We also have well-designed stimulus delivery systems and a state-of-the-art eye tracking (EyeLink 1000, SR Research Ltd.) as well as simultaneous EEG recording (BrainAmp MR+, Brain Products GmbH) and physiological signal recording/monitoring (BIOPAC Systems, Inc.) capabilities. We continue to offer exquisite surroundings for functional magnetic resonance imaging studies and neuroscience research.

As expected, in 2014 the magnet use was again, for a third year in a row, well over the 1000 paid hours mark. The total number of used hours (not including maintenance and free pilot hours) reached an all-time high of 1495, which means about 40% increase in comparison to the hours in 2013 (1066). As a general trend since 2008, the usage has been increasing and we are looking forward to further boosting the usage especially during outside prime-time (Mon–Fri, 9–16) hours by improving our services and teaching MRI usage within the Aalto NeuroImaging research infrastructure.

1.3 MEG Core

The main research instrument of the MEG Core is a modern 306-channel neuromagnetometer (Elekta Neuromag^{TM}, Elekta Oy, Helsinki), which was upgraded in 2008. It houses 204 gradiometers and 102 magnetometers with whole-scalp coverage. The device includes 64 EEG channels and 8 additional analog inputs for monitoring purposes. The MEG device is located within a 3-layer magnetically shielded room (MSR; Imedco AG, Hägendorf, Switzerland) that provides >100 dB attenuation of the external magnetic disturbances over a wide bandwidth. MEG Core has extremely low magnetic ambient noise level.

During MEG recordings, stimulators are available, *e.g.*, for auditory (Etymotic Research, Chicago, IL; ADU-2, Unides Design Ay, Helsinki; Sound Shower, Panphonics Oy, Tampere, Finland), tactile (constant current electric stimulator, (Medizin Technik Schwind, Germany), pneumatic tactile stimulator (built for the purpose in Germany), vibrotactile stimulator (built at BRU), manually-operated brush stimulator (built at BRU), visual (Panasonic 7700 DLP projector with a back projection screen), and pain (Neurotest thulium-YAG laser, Baasel Lasertech GmbH, Starnberg, Germany) stimulation. For monitoring purposes, MEG Core has eye trackers (SensoMotoric Instruments GmbH, Teltow, Germany and ASL Applied Science Laboratories, Bedford, MA USA), and home-made accelerometer-based monitoring devices. In addition, MEG Core has several home-made response pads and strong knowhow in building and testing MEG compatible stimulators. More information of the MEG Core is available at meg.aalto.fi.

2 Location, facilities, organization, and mission

The Aalto NeuroImaging infrastructure facilities are located on the campus of the Aalto University in Otaniemi area. Aalto TMS (tms.aalto.fi) and AMI Centre (ami.aalto.fi) are both located in the Magnet Building (Otakaari 5 I, Espoo, Finland), AMI occupying 360 m^2 in floors 1–3 and TMS

about 50 m^2 in the fourth floor. MEG Core (meg.aalto.fi) resides in Nano Building (Puumiehenkuja 2), having 120 m^2 of laboratory space. All three parts of the ANI infrastructure have a joint online reservation system at anitime.aalto.fi. For more detailed information, see ani.aalto.fi.

The main research tools at Aalto TMS are two neuronavigated transcranial magnetic stimulation systems (Bistim^2 and Rapid^2, The Magstim Company Ltd., United Kingdom) combined with electroencephalogram mapping (NeurOne, Mega Electronics Ltd., Kuopio, Finland). The laboratory is in very close proximity of our MRI scanner, making it very easy to combine anatomical MR-images to TMS neuronavigation, and to make offline fMRI-TMS studies accessible as well as perform concurrent TMS-fMRI measurements. PhD Juha Silvanto secured funding for the equipment in 2013 and preceded Professor Synnöve Carlson in leading the TMS laboratory.

Currently, AMI Centre maintains the 3T MRI scanner (Siemens Skyra, Siemens Healthcare, Erlangen, Germany), develops the related infrastructure, and offers services to research teams at and outside the Aalto University. AMI Centre aims to provide an innovative environment for development and promotion of new imaging methods based on magnetic resonance imaging. The AMI personnel develop new techniques in close collaboration with other users. In 2014, the AMI Centre's research fields included functional and structural brain imaging, diffusion tensor imaging (DTI) and tractography of white matter axon bundles, as well as development of new methods and applications of MRI technology. The technical director of AMI Centre is Staff Scientist, DrTech Toni Auranen.

MEG Core offers excellent environment for magnetoencephalographic (MEG) measurements. MEG Core has three strong supports, *i.e.*, a modern MEG device, a variety of stimulators and monitoring devices, and magnetically quiet laboratory space. The MEG Core with its low-noise, well-equipped environment is currently one of the world's best laboratories to make MEG research. In addition to Aalto NeuroImaging duties, Docent Veikko Jousmäki acts also as the MEG Core Director.

3 Achievements

Aalto NeuroImaging serves as an infrastructure that provides top-level brain imaging facilities for multiple research teams, among them many National Centers of Excellence selected by the Academy of Finland. ANI as such, has limited own research program, and thus the scientific achievements and key performance indicators listed below, containing data collected at ANI, reflect the research interests of all the users of the infrastructure in 2014.

Impact factors for the publication series are shown and the classification of the publications is based on the instructions by the Finnish Ministry of Culture and Education, 2010. The indication **TMS**, **AMI**, or **MEG** after the impact factor and classification mark, denote which resource or equipment was used in the work, respectively.

3.1 Scientific publications in international journals

PUBLISHED (situation Jan 2015)

1) Alho J, Lin F-H, Sato M, Tiitinen H, Sams M, and Jääskeläinen IP: **Enhanced neural synchrony between left auditory and premotor cortex is associated with successful phonetic categorization**. *Frontiers in Psychology* 2014, 5: 394. (IF 2.843, A1, **AMI**, **MEG**)

2) Boldt R, Gogulski J, Guzmán-López J, Carlson S, and Pertovaara A: **Two-point tactile**

discrimination ability is influenced by temporal features of stimulation. *Experimental Brain Research* 2014, 232: 2179–2185. (IF 2.168, A1, **AMI**)

3) Boldt R, Seppä M, Malinen S, Tikka P, Hari R, and Carlson S: **Spatial variability of functional brain networks in early-blind and sighted subjects**. *NeuroImage* 2014, 95: 208–216. (IF 6.132, A1, **AMI**)

4) Bona S, Herbert A, Toneatto C, Silvanto J, and Cattaneo Z: **The causal role of the lateral occipital complex in visual mirror symmetry detection and grouping: An fMRI-guided TMS study**. *Cortex* 2015, 51: 46–55. (IF 6.042, A1, **AMI**)

5) Burunat I, Alluri V, Toiviainen P, Numminen J, and Brattico E: **Dynamics of brain activity underlying working memory for music in a naturalistic condition**. *Cortex* 2014, 57: 254–269. (IF 6.042, A1, **AMI**)

6) Cong F, Puoliväli T, Alluri V, Sipola T, Burunat I, Toiviainen P, Nandi AK, Brattico E, and Ristaniemi T: **Key issues in decomposing fMRI during naturalistic and continuous music experience with independent component analysis**. *Journal of Neuroscience Methods* 2014, 223: 74–84. (IF 1.959, A1, **AMI**)

7) Gramfort A, Luessi M, Larson E, Engemann DA, Strohmeier D, Brodbeck C, Parkkonen L, and Hämäläinen MS: **MNE software for processing MEG and EEG data**. *NeuroImage* 2014, 86: 446–460. (IF 6.132, A1, **MEG**)

8) Hari R, Bourguignon M, Piitulainen H, Smeds E, de Tiège X, and Jousmäki V: **Human primary motor cortex is both activated and stabilized during observation of other person's phasic motor actions**. *Philosophical Transactions of the Royal Society B* 2014, 369: 20130171. (IF 6.314, A1, **AMI**, **MEG**)

9) Harinen K and Rinne T: **Acoustical and categorical tasks differently modulate activations of human auditory cortex to vowels**. *Brain and Language* 2014, 138: 71–79. (IF 3.309, A1, **AMI**)

10) Helenius P, Sivonen P, Parviainen T, Isoaho P, Hannus S, Kauppila T, Salmelin R, and Isotalo L: **Abnormal functioning of the left temporal lobe in language-impaired children**. *Brain and Language* 2014, 130: 11–18. (IF 3.309, A1, **MEG**)

11) Hultén A, Karvonen L, Laine M, and Salmelin R: **Producing speech with a newly learned**

morphosyntax and vocabulary: An magnetoencephalography study. *Journal of Cognitive Neuroscience* 2014, 26: 1721–1735. (IF 4.687, A1, **AMI**, **MEG**)

12) Hytönen K: **Neuroscientific evidence for contextual effects in decision making**. *Behavioral and Brain Sciences* 2014, 37: 33–34. (IF 18.571, A1, **MEG**)

13) Jiang P, Tokariev M, Aronen ET, Salonen O, Ma Y, Vuontela V, and Carlson S: **Responsiveness and functional connectivity of the scene-sensitive retrosplenial complex in 7–11-year-old children**. *Brain and Cognition* 2014, 92C: 61–72. (IF 2.683, A1, **AMI**)

14) Koskinen M and Seppä M: **Uncovering cortical MEG responses to listened audiobook stories**. *NeuroImage* 2014, 100: 263–270. (IF 6.132, A1, **MEG**)

15) Kujala J, Sudre G, Vartiainen J, Liljeström M, Mitchell T, and Salmelin R: **Multivariate analysis of correlation between electrophysiological and hemodynamic responses during cognitive processing**. *NeuroImage* 2014, 100: 207–216. (IF 6.132, A1, **AMI**, **MEG**)

16) Lahnakoski JM, Glerean E, Jääskeläinen IP, Hyönä J, Hari R, Sams M, and Nummenmaa L: **Synchronous brain activity across individuals underlies shared psychological perspectives**. *NeuroImage* 2014, 100: 316–324. (IF 6.132, A1, **AMI**)

17) Lamminmäki S, Parkkonen L, and Hari R: **Neuromagnetic responses to amplitude-modulated binaural tones, speech, and music**. *Ear and Hearing* 2014, 35: 461–467. (IF 2.833, A1, **AMI**, **MEG**)

18) Lankinen K, Saari J, Hari R, and Koskinen M: **Intersubject consistency of cortical MEG signals during movie viewing**. *NeuroImage* 2014, 92: 217–224. (IF 6.132, A1, **AMI**, **MEG**)

19) Malinen S, Renvall V, and Hari R: **Functional parcellation of human primary somatosensory cortex to natural touch**. *European Journal of Neuroscience* 2014, 39: 738–743. (IF 3.669, A1, **AMI**)

20) Mandel A, Helokunnas S, Pihko E, and Hari R: **Neuromagnetic brain responses to other person's eye blinks seen on video**. *European Journal of Neuroscience* 2014, 40: 2576–2580. (IF 3.669, A1, **MEG**)

21) Nevalainen P, Lauronen L, and Pihko E: **Development of human somatosensory cortical**

functions – what have we learned from magnetoencephalography: A review. *Frontiers in Human Neuroscience* 2014, 5: 158. (IF 2.900, A1, **MEG**)

22) Nummenmaa L, Saarimäki H, Glerean E, Gotsopoulos A, Hari R, and Sams M: **Emotional speech synchronizes brains across listeners and engages large-scale dynamic brain networks**. *NeuroImage* 2014, 102: 498–509. (IF 6.132, A1, **AMI**)

23) Nummenmaa L, Smirnov D, Lahnakoski J, Glerean E, Jääskeläinen IP, Sams M, and Hari R: **Mental action simulation synchronizes action-observation circuits across individuals**. *The Journal of Neuroscience* 2014, 34: 748–757. (IF 6.747, A1, **AMI**)

24) Raij TT, Korkeila J, Joutsenniemi K, Saarni SI, and Riekki TJ: **Association of stigma resistance with emotion regulation – Functional magnetic resonance imaging and neuropsychological findings**. *Comprehensive Psychiatry* 2014, 55: 727–735. (IF 2.256, A1, **AMI**)

25) Ramkumar P, Parkkonen L, and Hyvärinen A: **Group-level spatial independent component analysis of Fourier envelopes of resting-state MEG data**. *NeuroImage* 2014, 86: 480–491. (IF 6.132, A1, **MEG**)

26) Renvall V, Nangini C, and Hari R: **All that glitters is not BOLD: inconsistencies in functional MRI**. *Scientific Reports* 2014, 4: 3920. (IF 5.078, A1, **AMI**)

27) Riekki TJ, Lindeman M, and Raij TT: **Supernatural believers attribute more intentions to random movement than skeptics: An fMRI study**. *Social Neuroscience* 2014, 9: 400–411. (IF 2.873, A1, **AMI**)

28) Rinne T, Ala-Salomäki H, Stecker GC, Pätynen J and Lokki T: **Processing of spatial sounds in human auditory cortex during visual, discrimination and 2-back tasks**. *Frontiers in Neuroscience* 2014, 8: 220. (IF not available yet, A1, **AMI**)

29) Salmi J, Glerean E, Jääskeläinen IP, Lahnakoski JM, Kettunen J, Lampinen J, Tikka P, and Sams M: **Posterior parietal cortex activity reflects the significance of others' actions during natural viewing**. *Human Brain Mapping* 2014, 35: 4767–4776. (IF 6.924, A1, **AMI**)

30) Salminen-Vaparanta N, Vanni S, Noreika V, Valiulis V, Móró L, and Revonsuo A: **Subjective characteristics of TMS-induced phosphenes originating in human V1 and V2**. *Cerebral Cortex* 2014, 24: 2751–2760. (IF 8.305, A1, **AMI**)

31) Smirnov D, Glerean E, Lahnakoski JM, Salmi J, Jääskeläinen IP, Sams M, and Nummenmaa L: **Fronto-parietal network supporting context-dependent speech comprehension**. *Neuropsychologia* 2014, 63: 293–303. (IF 3.451, A1, **AMI**)

32) Tähkä S, Laiho A, and Kostiainen MA: **Diblock copolymer mediated self-assembly of protein stabilized iron oxide nanoparticle clusters for magnetic resonance imaging**. *Chemistry – A European Journal* 2014, 20: 2718–2711. (IF 5.696, A1, **AMI**)

IN PRESS (situation Jan 2015)

1) Alho K, Salmi J, Koistinen S, Salonen O, and Rinne T: **Top-down controlled and bottom-up triggered orienting of auditory attention to pitch activate overlapping brain networks**. *Brain Research* 2014, Electronic publication ahead of print. (IF 2.828, A1, **AMI**)

2) Bona S, Cattaneo Z, and Silvanto J: **The causal role of the occipital face area (OFA) and lateral occipital (LO) cortex in symmetry perception**. *The Journal of Neuroscience* 2014, Accepted. (IF 6.747, A1, **AMI**)

3) Gogulski J, Boldt R, Savolainen P, Guzmán-López J, Carlson S, Pertovaara A: **A segregated neural pathway for prefrontal top-down control of tactile discrimination**. *Cerebral Cortex* 2013–2014, Electronic publication ahead of print. (IF 8.305, A1, **AMI**)

4) Kirveskari E, Vartiainen NV, Kallio-Laine K, Kalso E, and Forss N: **Normal laser-evoked cortical responses in patients with chronic hemibody pain**. *European Journal of Pain* 2014, Electronic publication ahead of print. (IF 3.218, A1, **MEG**)

5) Liljeström M, Kujala J, Stevenson C, and Salmelin R: **Dynamic reconfiguration of the language network preceding onset of speech in picture naming**. *Human Brain Mapping* 2014, Electronic publication ahead of print. (IF 6.924, A1, **MEG**)

6) Nieminen JO, Koponen LM, and Ilmoniemi RJ: **Experimental characterization of the electric field distribution induced by TMS devices**. *Brain Stimulation* 2014, Accepted. (IF 5.432, A1, **TMS**)

7) Talja S, Alho K, and Rinne T: **Source analysis of event-related potentials during pitch discrimination and pitch memory task**. *Brain Topography* 2013–2014. Electronic publication

ahead of print. (IF 2.519, A1, **AMI**)

SUBMITTED (situation Jan 2015)

8) Alluri V, Toiviainen P, Burunat I, Bogert B, Numminen J, and Brattico E: **Musical training modulates functional connectivity of limbic regions during continuous music listening**. (**AMI**)

9) Bogert B, Numminen J, Numminen T, Sams M, and Brattico E: **The role of personality in implicit and explicit processing of musical emotions in the brain**. (**AMI**)

10) Burunat I, Brattico E, Bogert B, Lampinen J, Puoliväli T, Ristaniemi T, Sams M, and Toiviainen P: **Perception in action: symmetric auditory-motor functions in musicians**. (**AMI**)

11) Carlson E, Bogert B, Saarikallio S, and Brattico E: **Mood regulation, mood disorders and maladaptive limbic system responses in music listening – A correlational fMRI study**. (**AMI**)

12) Gilani I and Sepponen R: **Simulation and experimental verification of a rapid in-plane motion estimation method for functional magnetic resonance image time series**. (**AMI**)

13) Halko M-L, Mäkelä M, Nummenmaa L, Hlushchuk Y, and Schürmann M: **Hedonic context modulates risky choices and reward responses in amygdala and dorsal striatum**. (**AMI**)

14) Heikkinen H, Sharifian F, Vigario R, and Vanni S: **Feedback to distal dendrites links blood oxygenation level dependent signals to neural receptive fields in a spiking network model of the visual cortex**. (**AMI**)

15) Henriksson L, Hyvärinen A, Stenroos M, and Vanni S: **Encoding of spatial phase congruency in human visual area V3**. (**AMI**)

16) Hlushchuk Y, Simões-Franklin C, Nangini C, and Hari R: **Stimulus-rate sensitivity segregates area 3b of the human SI cortex.** (**AMI**)

17) Inverso S, Goh X-L, Henriksson L, Vanni S, and James AC: **Amplifying evoked potentials: A novel approach to reconstruct evoked currents from potentials using EEG and MRI to quickly separate V1 and V2 cortical sources using retinotopy constrained source estimation**. (**AMI**)

18) Liu C, Abu-Jamous B, Brattico E, and Nandi AK: **Towards consensus in clustering for studying functional brain connectivity during affective processing**. (**AMI**)

19) Moisala M, Salmela VR, Salo E, Carlson S, Vuontela V, Salonen O, and Alho K: **Brain activity during divided and selective attention to auditory and visual sentence comprehension tasks**. (**AMI**)

20) Nora A, Renvall H, Kim J-Y, Service E, and Salmelin R: **Distinct effects of memory retrieval and articulatory preparation when learning and accessing new word forms**. (**AMI**)

21) Pamilo S, Malinen S, Hotta J, and Seppä M: **A correlation-based method for extracting subject-specific components and artifacts from group-fMRI data**. (**AMI**)

22) Saad E, Wojciechowska M, and Silvanto J: **Partial dissociating in the neural bases of VSTM and visual imagery in the early visual cortex**. (**TMS**)

23) Salmela VR, Henriksson L, and Vanni S: **Radial frequency analysis of contour shapes in visual cortex**. (**AMI**)

24) Salo E, Rinne T, Salonen O, and Alho K: **Brain activations during bimodal dual tasks depend on the nature and combination of component tasks**. (**AMI**)

25) Sharifian F, Nummenmaa L, and Vanni S: **Adaptation decorrelates neural activation patterns in visual cortex**. (**AMI**)

26) Smeds E, Hari R, and Pihko E: **Observation of hands in crafting and social touch has differential effects on area 3b of the human primary somatosensory cortex**. (**MEG**)

27) Talja S, Ovaska N, and Rinne T: **Feature-specific and task-dependent processing of pitch and location in human auditory cortex**. (**AMI**)

28) Vanni S, Sharifian F, and Vigário R: **What functional magnetic resonance imaging can tell us about data processing in the cerebral cortex**. (**AMI**)

29) Vartiainen N, Hlushchuk Y, Kalso E, Forss N, and Hari R: **Central processing of bilateral versus unilateral acute pain in healthy human adults**. (**AMI**)

3.2 Other scientific publications in meetings and conferences

PROCEEDINGS PAPERS

1) Liu C, Fa R, Abu-Jamous B, Brattico E, and Nandi AK: **Scalable clustering based on enhanced-smart for large-scale fMRI datasets**. *Proceedings of International Conference on Acoustics, Speech and Signal Processing* 2014. (A4, **AMI**)

ORAL PRESENTATIONS, INVITED TALKS AND POSTERS

Our users reported **more than 30 oral presentations and invited talks as well as at least 30 posters in international and national scientific conferences and meetings** that contain data and/or results based on the fMRI/MRI, MEG or TMS data measured at Aalto NeuroImaging infrastructure. The reader is recommended to take into consideration that the achievements in this category are based solely on notifications from our users and the true number might be considerably higher. Therefore, they are not listed with detailed information.

3.3 Theses

DOCTORAL THESES

1) Robert Boldt: **Functional and anatomical brain networks. Brain networks during naturalistic auditory stimuli, tactile stimuli and rest. Functional network plasticity in early-blind subjects**. Dissertation for the degree of Doctor of Medicine, University of Helsinki, Faculty of Medicine, Institute of Biomedicine, 2014. Supervisor: Professor Synnöve Carlson. (Thesis made at Aalto University, School of Science, O.V. Lounasmaa Laboratory, Brain Research Unit and University of Helsinki, Institute of Biomedicine, Neuroscience Unit.) (G5, **AMI**)

2) Juha Lahnakoski: **Brain Mechanisms Underlying Perception of Naturalistic Social Events**. Dissertation for the degree of Doctor of Science in Technology, Aalto University, School of Science, Department of Biomedical Engineering and Computational Science, 2014. Supervisor: Professor Mikko Sams, Advisor: Professor Lauri Nummenmaa. (G5, **AMI**)

3) Tapani Riekki: **Neuro-cognitive factors contributing to paranormal beliefs: core knowledge violations, cognitive inhibition, and the social brain**. Dissertation for the degree of Doctor of Philosophy, University of Helsinki, Institute of Behavioural Sciences, 2014. Supervisor: Docent Marjaana Lindeman. (G5, **AMI**)

4) Niina Salminen-Vaparanta: **The neural processes generating visual phenomenal consciousness: ERP and neuronavigated brain stimulation studies**. Dissertation for the degree of Doctor of Philosophy, University of Turku, Department of Behavioural Sciences and Philosophy, 2014. Supervisors: Professor Antti Revonsuo, Docent Mika Koivisto, and Docent Simo Vanni. (G5, **AMI**)

MASTER'S THESES

1) Heidi Ala-Salomäki: **Etäisyyden, tulosuunnan ja tilan suhteen vaihtelevien äänien prosessointi kuuloaivokuorella erottelu- ja muistitehtävien aikana: fMRI-tutkimus**. Master's thesis for the degree of Master of Science (Psychology), University of Helsinki, Institute of Behavioural Sciences, 2014. (G2, **AMI**)

3.4 Other publications / Promoting public awareness

The reader is recommended to take into consideration that the achievements in this category are based on notifications from our users and from the information that ANI personnel have from other sources. The true number of **publications for the general public** may thus be considerably higher.

Aalto TMS / MEG Core: Interview/Footage for TV-program *Prisma Studio* about TMS and MEG. 14 March 2014. (**MEG**, **TMS**)

Alho K: Public panel discussion at *Tiedekulma, Porthania, University of Helsinki*. **Koneiden ehdolla**. 12 March 2014. (**AMI**)

AMI Centre: Background footage for TV-program *MOT*. **Masentavat lääkkeet**. 26 May 2014. (**AMI**)

AMI Centre and MEG Core: Background footage for *Aalto Snapshot Youtube channel*. **Brain-to-Brain Neuroscience**. https://www.youtube.com/watch?v=gP9fKQyLHrw 2014. (**AMI**, **MEG**)

Brattico E: Newspaper interview for *Helsingin Sanomat*. **Musiikki virittää aivot**. 30 July 2014. (**AMI**)

Carlson S: Panel discussion at *Brain Awareness Week, Public Events*. **Voiko aivotutkija lukea mieltäsi?** 11 March 2014. (**AMI**)

Forss N and Vartiainen N: Article in *Duodecim*. **Krooniseen kipuun liittyvien aivomuutosten kuvantaminen**. 130/2014, 1507–1514. (**MEG**)

Halko M-L: Lecture in *Mikkelin Akatemia, Yli Rajojen*. **Järki vai tunteet?** 11 January 2014. (**AMI**)

Halko M-L: Lecture at *PwC Women, Footprint, feelings and future*. **Järki ja tunteet**. 7 March 2014. (**AMI**)

Halko M-L: Lecture at *Tiirasaari Investment Summit*. **Tunteiden merkitys päätöksenteossa**. 28 August 2014. (**AMI**)

Hari R: Invited talk at *Terveyttä taiteesta –seminaari*. **Taide ja aivot**. 21 July 2014. (**AMI**, **MEG**)

Hari R: Panel discussion at *Brain Awareness Week, Public Events*. **Voiko aivotutkija lukea mieltäsi?** 11 March 2014. (**AMI**)

Hari R: Interview for *Electronic Academy of Finland*. **Kahden ihmisen neurotiede selvittää ihmisen sosiaalisuutta**. 6 March 2014. (**AMI**, **MEG**)

Hari R: Interview for TV-program *Prisma Studio*. **Voimmeko luottaa, mitä näemme, kuulemme tai tunnemme? Näin syntyvät aistiharhat. Mitä taikuri haluaa meidän näkevän?** 11 March 2014. (**AMI**, **MEG**)

Heikkinen H: Interview and participation in TV-program *YLE:n Aamu-TV*. **Mitä aivokuvat kertovat tunteistamme?** 1 December 2014. (**AMI**)

Heinonen J: Article in *Kehittyvä Elintarvike*. **Aivot, luovuus ja innovatiivisuus**. 6/2014. (**AMI**)

Hytönen K: Talk at citizen info of *Mainonnan valta –seminar*. **Kuinka ympäristö vaikuttaa päätöksiimme?** 30 January 2014. (**AMI**)

Hytönen K: Talk at *Sijoitus–Invest 2014*. **Tunne ja järki talous-päätöksen synnyssä**. 12 November 2014. (**AMI**)

Hytönen K: Several citations of interview on neuromarketing and decision making in 2014, cited in www-versions of *Wall Street Journal, Ilkka, Pohjalainen, Taloussanomat, Markkinointi&Mainonta, Kauppalehti,* and *Tekniikka&Talous*. (**AMI**)

Jääskeläinen I: Background material in interview for TV-program *Prisma Studio*. 2 December 2014. (**AMI**)

Lindsberg PJ, Castrén E, Korkeila J, Alho H, Erkinjuntti T, Isometsä E, Kalso E, Karlsson H, Marttunen M, Pihko H, Tienari P, Wartiovaara A, Jäkälä P, Kälviäinen R, Soininen H, Tiihonen J, Karlsson H, Rinne J, Roine RO, Elovaara I, Tamminen T, Öhman J, Majamaa K and Hari R: Article in *Duodecim*. **Aivosairaudet ovat kalleimmat kansantautimme**. 130/2014, 1721–1730. (**MEG**)

Maunula S: Interview in www-article of *Vantaan Sanomat*. **Rakennusliike kutsui tornitaloasumisesta kiinnostuneet magneettikuvaukseen**. 24 October 2014. (**AMI**)

Maunula S: Interview in www-article of *Talouselämä*. **Mitä ihmettä? VS: Tornitaloasumisesta kiinnostunut kutsuttiin magneettikuvaukseen**. 24 October 2014. (**AMI**)

Nora A: Lecture for volunteer participants in seminar for *Aivokummit*. **Kieli ja aivot? Kielen aivoperustan tutkimus Aivotutkimusyksikössä**. 31 October 2014. (**AMI**, **MEG**)

Nummenmaa L: Interview for *YLE TV1* program *Puoli Seitsemän*. 20 February 2014. (**AMI**)

Nummenmaa L and Hari R: Article in *Tiede*. **Aivot rakastavat seuraa**. 4/2014, 32–36. (**AMI**, **MEG**)

3.5 Scientific awards and positions of trust

Senior Scientist **Veikko Jousmäki** has been acting as a member of the scientific advisory board of the National facility for MEG (NatMEG) at Karolinska Institutet, Stockholm, Sweden (selected for a 2-year period in 2013).

3.6 Summary of achievements

This table depicts a summary of the highlights of the achievements presented in this chapter and from previous years since Aalto NeuroImaging started to operate in 2013.

	Refereed papers*	**In-press + submitted papers***	**PhD theses**	**MSc theses**
ANI total 2014	**33**	**7 + 22**	**4**	**1**
TMS used in	*0*	*1 + 1*	*0*	*0*
AMI used in	*26*	*4 + 20*	*4*	*1*
MEG used in	*13*	*2 + 1*	*0*	*0*
ANI total 2013	**32**	**13 + 16**	**5**	**4**
TMS used in	*0*	*0 + 2*	*0*	*1*
AMI used in	*25*	*11 + 12*	*5*	*2*
MEG used in	*11*	*4 + 2*	*0*	*1*

* Including refereed conference proceedings papers

4 Technical development

While keeping the infrastructure operational and of the highest quality for our users, ANI infrastructure personnel is also actively involved in many technological and methodological development projects that may not result in publications, but stand out as improved services and possibilities for the users to benefit from the infrastructure. Below, some important projects and advances made in 2014 are described. Many of these projects are done in direct collaboration with our users and, therefore, they often interact with academically funded research projects listed in the previous chapter.

AALTO TMS

Improving of Aalto TMS laboratory's facilities continued in the year 2014. Construction of the lab's facilities included starting the development of a concurrent TMS-fMRI system. To serve this purpose, a visit to SNS lab (The Laboratory for Social and Neural Systems Research, University of Zürich) in Zürich was organized in order to learn about their concurrent TMS-fMRI system. New software version of Visor2.1 neuronavigation software was purchased. The new software version has many improvements compared to the previous one for example enabling the use of neuronavigation with two stimulating coils simultaneously. During the software update process some problems with the old neuronavigation tools were observed and tools are being replaced to new ones.

KAR ADU1c audio stimulator was purchased to Aalto TMS to enable audio stimulations and white noise masking. ASL chin/cheek rest was bought for mounting test subject's head in place during visual studies or/and preventing test subject movement under stimulating coil during TMS studies. A real electro-magnetic placebo device for sham TMS was built and the testing phase of the device is currently ongoing. In addition, a number of small improvements to the facilities of Aalto TMS were done to facilitate the usability of the laboratory.

In 2015 Aalto TMS will aim to have more scientific projects and some improvements in the facility following the needs of the researchers. In addition, Aalto TMS is participating in planning seminars to ANI users. Users' training will also be held to train and attract new users.

AMI CENTRE

We have been very pleased with the Siemens Skyra scanner since its installation at the end of 2011. In August 2014, we acquired the Siemens TimTX TrueShape and syngo ZOOMit –update enabling the latest possibilities in using parallel transmission (pTX) and shimming in MRI and fMRI. The funding for the update was secured from Academy of Finland FIRI 2013 –call with a joint NEUROIMAGING application with the BioMag laboratory. This update should improve image quality (less artefactual distortion and blurring, as well as diminished detrimental effects of motion and flow), or alternatively, parallel imaging may be exploited to scan a target notably faster than prior to the update. As an important feature, the fully dynamic pTX makes it possible to create a zoomed field-of-view (FOV) to enable improved spatial resolution and reduced ghosting for small target areas than without pTX-methods. With the same update, the scanner software was updated to VD13C-level. Earlier in the year, AMI purchased the RESOLVE –sequence for performing multishot diffusion weighted imaging. This may prove to be useful in acquiring high-resolution and high-quality diffusion weighted images in special cases, and also when imaging locations with strong susceptibility artefacts. Previously, AMI Centre has also trained personnel for making sequence code modifications with the

Siemens IDEA environment. Slight modifications have been needed so far in couple of pilot projects.

In the very beginning of 2014, we started the full use of a new Full HD Panasonic 3-DLP projector (PT-DZ110XE) for visual stimulation. Building of the setup was a tedious task due to, *e.g.* customizing the optics to the projector. The old projector will be available as a backup projector and for backward compatibility for older research projects.

As previously, measurements of combined EEG–fMRI, eye-tracking, and acquisition of galvanic skin response and other physiological signals, such as respiration, plethysmography, EKG, and EMG, have been routinely performed throughout the year in AMI Centre. Several smaller upgrades took place during 2014, such as the EEG-system (Brain Products GmbH) computer update, improvements with the fORP response system (Current Designs, Inc.) and improvements in acoustic isolation of our ADU auditory stimulus delivery system. Our staff constantly follows the current trends in fMRI stimulation/response systems and attended several roadshows of different manufactures as well. All our devices (both custom-made and commercial ones) are available to all users of AMI Centre.

In 2014, AMI Centre has continued collaborating with DrTech Ville Renvall (Aalto University School of Science (AU SCI), O.V. Lounasmaa Laboratory, Brain Research Unit; and AU SCI, Department of Biomedical Engineering and Computational Science, Human Emotion Systems Lab) on developing a two-person fMRI measurement setup. This ongoing development project includes, for example, a custom-built 2-person headcoil for the Siemens Skyra scanner. As mentioned in the previous chapter, AMI Centre is involved in building a concurrent TMS-fMRI measurement setup with Aalto TMS. This work is going to continue in 2015 with the first pilot setup expected to be ready for testing by the end of the year.

AMI Centre's quality assurance (QA) procedures have been in use for many years with no noticeable changes. In fall 2013, Hanna-Leena Halme performed a literature review of current MR-QA routines used in the world (focusing in fMRI and DTI) in her special assignment and made a preliminary plan to improve the procedures currently in use at AMI Centre. This project continued in 2014 with summer student Laura Jukola starting to test and implement some of the plans. This project was not yet finished and will continue in 2015 as well.

In 2015 we continue improving our stimulus systems to meet the demands from our users. In addition, we are finding sources for funding the 128-channel RF-receiver expansion for Siemens Skyra as well as a new 64-channel head/neck coil for advanced fMRI purposes.

MEG CORE

MEG Core has tested and developed further gadgets for MEG measurements. These gagdets include devices based on pneumatic artificial muscles (PAMs) suitable for producing passive finger movements in MEG recordings. The stimulus computers and stimulator racks have been upgraded in 2014.

MEG Core has also upgraded the technical research agreement with Elekta Oy in 2014. Within this contract, we have developed and tested new Elekta products. In addition, we have trained new Elekta MEG users at MEG Core.

In 2015, MEG Core will continue to improve the facility with the main emphasis on the stimulators and monitoring devices.

5 Equipment use and infrastructure funding

AALTO TMS

Total number of invoiced hours in 2014 was 120.5. A total of 42 hours was used to user and safety courses. A total of 22.5 hours was used for free piloting. Approximately 5 hours was used to demonstrate the laboratory to various interested parties. In addition a total of approximately 50 hours the laboratory was used to technical development and service. In the second year of operation, the total number of used hours in Aalto TMS was unfortunately below the expected although the amount of invoiced hours seems to increase slowly. There are two main explanations to the low usage hours in Aalto TMS; the start-up phase took longer than estimated and, in addition, there is currently a lack of post-doc level TMS researchers in Aalto TMS user base.

	AALTO TMS (hours used)		**2014**
	2013	**2014**	**%**
Users			
BRU	*118.5*	98	51.6
UH	-	22.5	11.8
Training	*11*	42	22.1
Demos, Workshops, Visitors	*28*	5	2.6
Free pilots	-	22.5	11.8
All users total	***157.5***	**190**	**100.0**
Service	*100*	*50*	

MEG CORE

The total use of MEG Core was 1006 hours (service hours excluded). The usage was reduced from the last year. BRU, BECS, and Elekta training were the main users of the facility.

	MEG Core (hours used)		**2014**
	2013	**2014**	**%**
Users			
MEG Core/BRU	*754*	329	32.7
HUS collaboration	*265*	24.5	2.4
BECS	*196*	159.5	15.9
Outside visitors	*19*	18	1.8
Elekta (intro training)	*64*	188.5	18.7
Elekta (service training)	*135*	29.5	2.9
Courses	-	4	0.4
Visitors	-	54	5.4
Free pilots	-	200	19.9
All users total	***1433***	**1006**	**100.0**
Service (helium refills)	*156*	*207*	

AMI CENTRE

In 2014, the total use of AMI Centre's magnet reached an all-time high of 1495 hours (out of which almost 80% during prime time). The biggest single users were University of Helsinki users (several groups from many departments added up to 35% of the total). From Aalto University, the biggest users were Department of Biomedical Engineering and Computational Science (24.5%) and Brain Research Unit of the O.V. Lounasmaa laboratory (12%). The use of aivoAALTO project (8.5%) ended in 2014. University of Helsinki groups increased their usage considerably as did other outside users, notably National Insitute for Health and Welfare (THL) and Laurea University of Applied Sciences.

Radiographer assistance is still very much needed and extremely important part of our operation as many groups measure only during prime time (Mon–Fri, 9–16) when this service is available. Last-minute cancellations have increased during the past four years, but on the other hand, the new Siemens scanner has proven to be very stable, decreasing the need for maintenance during prime time hours.

	AMI CENTRE (hours used)											**2014**
	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	**2014**	**%**
Aalto users												
BECS	*173*	*168*	*194.5*	*98*	*85*	*84*	*108*	*194*	*50*	*231*	365.75	24.5
BRU	*286*	*529*	*479.5*	*622*	*339*	*253*	*227*	*335*	*286*	*185*	178.25	11.9
aivoAALTO	-	-	-	-	-	*28*	*252*	*115*	*177*	*201*	125.5	8.4
AMI Centre[1]	*230*	*151*	*154*	*85*	*27*	*46*	*56*	*47*	*92*	*39*	71.5	4.8
NeuroCine	-	-	-	-	-	-	-	-	-	-	10	0.7
Acoustics	-	-	-	-	-	-	*7*	*7*	-	*3*	-	0
SHOK	-	-	-	-	-	-	-	*44*	*30*	-	-	0
BIT Research Centre	-	-	-	-	-	-	-	*2*	-	-	-	0
Applied Electronics Laboratory	-	*16*	-	-	-	-	-	-	-	-	-	0
Aalto users total	***689***	***864***	***828***	***805***	***451***	***411***	***650***	***744***	***635***	***659***	**751**	**50.2**
Outside users												
UH	*115*	*76*	*81.5*	*126*	*126*	*172*	*268*	*131*	*339*	*286*	526.5	35.2
HUS	*37*	*19*	*18*	*10*	*10*	*4*	*4*	*5*	*82*	*60*	43	2.9
Other academic	*283*	*35*	*27.5*	*7*	*24*	*91*	*10*	*63*	*57*	*61*	174.5	11.7
Others (industry etc.)	*2*	*9*	*50*	*20*	*40*	*47*	*35*	*16*	*3*	-	-	0
Outside users total	***437***	***139***	***177***	***163***	***200***	***314***	***317***	***215***	***481***	***407***	**744**	**49.8**
All users total	***1126***	***1003***	***1005***	***968***	***651***	***725***	***967***	***959***	***1116***	***1066***	**1495**	**100.0**
Radiographer	-	-	-	*577*	*410*	*508*	*663*	*553*	*641*	*647*	744.5	
Radiographer %	-	-	-	*60%*	*63%*	*70%*	*69%*	*58%*	*57%*	*61%*	50%	
Maintenance[1, 2]	-	-	-	*214*	*234*	*218*	*212*	*735*[3]	*180*	*185*	195	
Free pilots[1]	-	-	-	-	-	-	*5*	*13*	*6*	*5*	10.5	
Cancellations[4]	-	-	-	*~30*	*~20*	*~5*	*~5*	*32*	*55*	*65*	180.5	

[1] Not invoiced: Service times, AMI Centre's technical development projects, Complimentary phantom pilots

[2] Includes: GE/Siemens maintenance (prime time only), AMI maintenance, trainings, visits

[3] Including the 3-month downtime for Scanner change (approx. 575 prime time hours)

[4] Late cancellations (not invoiced): 1. Subject notification (force majour) 2. Contraindication 3. Other reasons

INCOME AND OPERATING COSTS 2014

In 2014, the total income (972 k€) was close to the estimated budget. The income came from user fees (529 k€) and basic funding (443 k€). The total expenses were 1 075 k€ (expenses in MEG Core were 368 k€, AMI Centre 538 k€, and Aalto TMS 169 k€) signifying that the budget was 103 k€ on the negative side.

AMI Centre, reaching an all time record in the used hours was able to meet the planned budget with only about 30% of basic funding (planned 40%). MEG Core needed more support (approximately 60%) from ANI basic funding to compensate for some of the ceased large projects (*e.g.*, aivoAALTO) in 2014. Aalto TMS (still in take-off phase) was heavily supported (approximately 90 %) by ANI to make the startup possible.

Compensating with the excess of previous years, the cumulative sum is currently -14 k€.

6 Safety, teaching, seminars, visitors, and travel

AALTO TMS

Aalto TMS laboratory's own safety and user training course which is a prerequisite for all TMS measurements at Aalto TMS was organized 7 times during 2014 and was attended by a total of 19 participants (9 foreigners).

The highlight of the year was the "TMS-fMRI Workshop 2014" (30th October, 2014) organized by Aalto Brain Centre (ABC) and Aalto NeuroImaging (ANI). This event was organized in order to promote TMS research at Aalto University, to discuss challenges related to combining TMS-fMRI, and to learn about studies and researchers who have successfully applied these methods simultaneously. The workshop also continued our efforts (*e.g.*, Aalto TMS Symposium in 2013) of bringing foreign speakers to promote TMS usage at Aalto University. The workshop consisted of 5 lectures, with 3 foreign speakers and was participated by 48 individuals (19 foreigners). After the lectures, a site visit to Aalto TMS laboratory for the invited speakers was organized.

In addition, Aalto TMS housed a demonstration of navigated TMS (4th November, 2014) for a course "TRANSMED: Imaging in Science and Medicine" organized by University of Helsinki. 7 students attended the session. The Director of Aalto University Health Factory also visited Aalto TMS on 21st of November.

Aalto TMS laboratory's laboratory engineer, MSc Mikko Nyrhinen, attended to the 2nd TMS-EEG summer school "Probing Brain Dynamics" in Porvoo, organized by Department of Biomedical Engineering and Computational Science (BECS), Biomedicum Helsinki, and Aalto University on 8th–13th of September. He also attended to national clinical neurophysiology days at Turku on 12th–14th of November. Together with DrTech Toni Auranen (AMI Centre; Technical Director) and Professor Synnöve Carlson (Aalto TMS; Scientific Director) he also visited the "Laboratory for Social and Neural Systems Research (SNS Lab)" in the University of Zurich on 23th of September. The purpose of the visit was to get first hand experience about SNS Lab's concurrent TMS-fMRI setup.

AMI CENTRE

AMI Centre organizes its own MRI safety course, which is a prerequisite for all MRI scanner users at AMI. It was organized 5 times during 2014 and a total of 37 individuals (10 foreigners) passed it (altogether 463 people have passed it since 2002). Some people, who have not been doing measurements in MRI for a couple of years, have participated in the course again to refresh their safety knowledge related to magnetic resonance imaging.

AMI personnel hosted several informal visits by groups or individuals of students, researchers, science reporters, and television crews. In August, an internal user training for the Siemens TimTX TrueShape and syngo ZOOMit –update (teaching by Siemens application specialist, Magnus Karlsson) was held. Five ANI staff members participated in the training. A similar internal on-site training was organized earlier to learn about the new RESOLVE imaging sequence. The knowhow from these type of events is further delivered to our magnet user groups by arranging demonstrations of new equipment and magnet use, often based on user's requests and tailored to their specific needs. In addition, professor Lauri Parkkonen from BECS utilized the AMI Centre's scanner in teaching the course "BECS-114.5792 Brain Imaging Practice" in fall 2014.

During 2014, the AMI Centre's safety committee (whose members were Toni Auranen, Riitta Hari, Veikko Jousmäki, Ville Renvall, and Raimo Sepponen) had email exchanges and couple of meetings (not including all members) in which safety issues and procedures of testing new devices for the MRI environment were evaluated. Additional scientific talks related to AMI activities were included in the joint laboratory seminars of the Brain Research Unit (O.V. Lounasmaa Laboratory) and the Department of Biomedical Engineering and Computational Science.

DrTech Toni Auranen, Professor Synnöve Carlson, and MSc Mikko Nyrhinen visited University of Zurich on 23rd of September. The purpose of the visit was to get first hand experience about concurrent TMS-fMRI setup. Research assistant Tuomas Tolvanen visited roadtrips by BIOPAC Systems, Inc., SensoMotoric Instruments and their respective Finnish partners as well as participated in Aalto University's content management system (CSM) trainings together with MSc Mikko Nyrhinen for the purpose of maintaining ANI, NEUROIMAGING and FIFI webpages.

MEG CORE

BRU organized 3 international Elekta Neuromag Triux introductory MEG courses, each lasting for 5 days and including both lectures and hands-on data acquisition and analysis sessions, and one Elekta Neuromag service training. The courses were carried out in collaboration with Elekta Oy. The majority of the participants came from abroad (Toronto, Canada; Gurgaon, India; Philadelphia, USA), mainly from new MEG installation sites of Elekta Oy. 22 participants attended the introductory training, In addition, the Elekta Service Training was organized at MEG Core.

7 Aalto NeuroImaging personnel

7.1 Aalto TMS, AMI Centre, MEG Core

DIRECTORS

Veikko Jousmäki, ANI & MEG Director, PhD, Docent, Senior Scientist (**MEG**)

Synnöve Carlson, TMS Scientific Director, M.D., Ph.D., Professor of Practice (**TMS**)

Toni Auranen, AMI Technical Director, DrTech, Staff Scientist (**AMI**)

OTHER PERSONNEL

Mia Illman, MEG Technologist (**MEG**)

Laura Jukola, Summer Student (~3 months for **AMI**)

Helge Kainulainen, Technician (**MEG**)

Marita Kattelus, Radiographer (**AMI**)

Karel Kaurila, Civil Service Worker (minor duties for **ANI**)

Mikko Nyrhinen, Laboratory Engineer, MSc (**TMS**)

Petteri Räisänen, System Administration/Technical Support (~1 day per week for **ANI**)

Veli-Matti Saarinen, Laboratory Engineer, MSc (~0.5 months for **ANI**)

Ronny Schreiber, System Administration/Technical Support (~1 day per week for **ANI**)

Tuomas Tolvanen, Research Assistant (**AMI**)

7.2 Users and collaborators of ANI (n = 214)

The persons listed below are either, *authors* in scientific publications and theses where Aalto NeuroImaging is indicated in the byline or where data measured at any part of ANI (Aalto **TMS**, **AMI** Centre, **MEG** Core) were used in 2014 (2013 in parentheses), and/or they are members of research teams collecting data or carrying out research on data collected at ANI; the latter names have been collected from the active research permissions as well as project information and user notifications delivered to ANI in 2014. Also the employees of ANI who are performing measurements are listed here.

The total number of users and collaborators of the Aalto NeuroImaging infrastructure in 2014 (2013) adds up to 214 (220) individual researchers [61 (65) foreigners, 126 (112) individual authors] with AMI Centre affiliating to 174 (189), MEG Core to 76 (51), and Aalto TMS to 10 (5) of them. Out of the total, 112 (113) were affiliated with Aalto University, 45 (51) with University of Helsinki and 20 (10) with HUS, some with double or triple affiliations.

Abbreviations: *AU = Aalto University*
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