

TERVISETEHNOLOOGIATE INSTITUUT 2022. aasta teadus- ja arendustegevuse ülevaade

Instituudi olulisemad edulood

1. Eesti IT-teaduse tippkeskus EXCITE seminari korraldamine (Prof. Fridolin TK EXCITE koordinaator ja üks peaesineja) „Tulevik kuulub uudishimulikele“, Proto avastustehas, Nobeli saal, Tallinn, Estonia, 9.03.2022, <https://onlineexpo.com/ee/excite-konverents/conference/>;
<https://www.youtube.com/watch?v=Nw8suH02FAC>

Tippkeskus EXCITE ühendab Eesti IT-teaduse absoluutseid tippe, eesmärgiga uurida ja välja töötada meetodid turvaliste ja töökindlate IT-süsteemide ja -teenuste arendamiseks. EXCITE teadlased arendavad teaduslike meetodite abil kindlaid ja usaldusväärseid IKT-süsteeme, rakendades neid kõikjal, kus võimalik – keskendudes muuhulgas tervishoiu, ohutuse, keskkonnakaitse, panganduse jmt valdkondadele.

Tulevik kuulub neile, kes ei karda katsetada, avastada, esitada küsimusi ning pöörata senised arusaamad pea peale. Tallinna Tehnikaülikool, Tartu Ülikool ja AS Cybernetica kutsusid 9. märtsil Proto Avastustehas Nobeli saalis toimuvale EXCITE konverentsile heitmaks koos pilku tulevikku ning sõnastamaks IT valdkonna järgmiste aastate väljakutsed ja eesmärgid, mida Eesti e-tiiger püüdma võiks hakata. Konverentsi modereeris Johannes Tralla. Konverents oli eesti keeles inglisekeelse sünkroontõlkega. Vt ka EST - https://issuu.com/erilahendused/docs/excite_2021_est (Eesti IT-teaduse tippkeskus EXCITE erinumber “Eesti IT-teaduse tippkeskus EXCITE”, Ekspress Meedia AS Erilahenduste osakond).

2. FinEst Targa Linna Tippkeskuse „Linnaplaneerimise heaolu skoori“ pilootprojekti käivitamine. <https://www.finestcentre.eu/article-urban-planning-well-being-est> vt ka: <https://taltech.ee/targa-linna-tippkeskus#p53652>
3. Taltechi Tervisetehnoloogiate instituudi e-Meditiini keskus viis 2020 märts kuni 2022 oktoober Majandus- ja Kommunikatsiooniministeeriumi koolitushanke raames läbi „Digioskuste arendamise koolitused perearstidele ja -õdedele“, mille läbis 500 inimest, kellest 60% olid arstid ja 40% pereõed. Koolitus jõudis igasse Eesti maakonda. Osalejate tagasiside põhjal meeldis neile kõige rohkem igapäevatoos kasutatav ja tulevikku suunatud vaade ning koolitusel käsitletud teemad tõstatasid uusi küsimusi, mistõttu oodatakse ka jätkukoolitusi.
Projekti rahastati Euroopa Sotsiaalfondi toetuskeemist „Digitaalse kirjaoskuse suurendamine“.

Aju bioelektriliste signaalide uurimisgrupp

Uurimisrühma juht: Maie Bachmann, professor, 620 2202, maie.bachmann@taltech.ee

Liikmed:

Hiie Hinrikus, vanemteadur, emeriitprofessor;

Jaanus Lass, vanemteadur;

Laura Päeske, teadur;

Tuuli Uudeberg, nooremteadur-doktorant;

Marietta Gavriljuk, spetsialist

Võtmesõnad: signaalitöötlus, elektroentsefalograafia, aju häired (sh depressioon)

Kompetentsid

Uurimisgrupp omab kompetensi interdistsiplinaarsel infotehnoloogia ja aju füsioloogia puutealal. Uuringud on suunatud aju elektroentsefalograafilises (EEG) signaalis mentaalsete häirete (sh depressioon), tööstressi või keskkonna (mikrolainekiirgus) poolt tingitud muutuste avastamisele ja tõlgendamisele. Uurimisgrupi poolt väljatöötatud EEG spektraalse asümmeetria indeks (SASI) on tõestanud end kui perspektiivne meetod erinevates rakendustes.

Osalemine projektides

- TAR16013 (EXCITE) "IT Tippkeskus EXCITE (2016–2023)", PI M. Kruusmaa;
- 5GEMF1 "Hinnang praegustele ja 5G kasutuselevõtmisega kaasnevatele võimalikele tervisemõjudele, mis on seotud mitteioniseeriva kiirgusega" (2021-2022), PI Maie Bachmann;
- AR20013 „Targa linna tippkeskus“ (2022-2023), PI Ralf-Martin Soe;
- COST Action CA19127 *Cognitive decline in Nephro-Neurology: European Cooperative Target* (2020-2024);
- COST Action CA18106 *The neural architecture of consciousness* (2019-2023).

Teaduspublikatsioonid (valik)

- Hinrikus, H. et al. (2022) Limiting exposure to radiofrequency radiation: the principles and possible criteria for health protection, *International Journal of Radiation Biology*, DOI: 10.1080/09553002.2023.2159567
- Uudeberg, T. et al. (2022) Changes in EEG Measures of a Recipient of the mRNA COVID-19 Vaccine - A Case Study. 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Glasgow, Scotland, United Kingdom, 2022, pp. 3702-3705, doi: 10.1109/EMBC48229.2022.9871524.
- Pépin, M. et al. (2022). Cognitive disorders in patients with chronic kidney disease: specificities of clinical assessment. *Nephrology Dialysis Transplantation*. DOI: 10.1093/ndt/gfab262.

Tähtsamad tulemused

- Objektiivsed EEG signaalil põhinevaid mõõdikuid tuvastavad mRNA COVID-19 vaktsiinist põhjustatud muutused ja taastumise.
- Raadiokiirguse bioloogilise kui ka tervisemõju lävend põhimõtteliselt puudub, samas terviseriski saab minimeerida sidudes tervisekaitse piirväärtused kiirguse tasemega, mille puhul pika toimeaja jooksul ei ole märgatud olulist tervisemõju (6 V/m).

Uurimisrühma veebilehe aadress

<https://taltech.ee/biosignaalide-tootluse-labor>

Uurimisrühma seotus TalTech TA prioriteetse suunaga

- Tervisetehnoloogiad
- Usaldusväärsed IT-lahendused

Teadusvaldkond

- | | |
|---------------------------|----------------------------------|
| 1. Loodusteadused | 1.2 Arvutiteadus ja informaatika |
| 2. Tehnika ja tehnoloogia | 2.6 Meditsiinitehnika |

Teaduseriala

T115 Meditsiinitehnika
T121 Signaalitöötlus

Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös

COST Action CA19127 Maie Bachmann, juhtkomitee liige
COST Action CA18106 Maie Bachmann, juhtkomitee liige
International Academy for Medical and Biological Engineering (IAMBE), Hiie Hinrikus, fellow
European Alliance for Medical and Biological Engineering and Science (EAMBES) Hiie Hinrikus, fellow

Käimasolevate projektide/lepingute tulemusi saab rakendada:

Tervishoius. Tööohutuses. Linnaplaneerimises

Peamised koostööpartnerid

Välispartnerid:

Nalecz Institute of Biocybernetics and Biomedical Engineering Polish Academy of Sciences, Warsaw, Poland
Laboratory for Human Brain Dynamics, AAI Scientific Cultural Services Ltd., Nicosia, Cyprus
French National Institute for Industrial Environment and Risks (INERIS), France

Eesti koostööpartnerid:

Qualitas Arstikeskus
Põhja-Eesti Regionaalhaigla
Narva Linn

Sensortehnoloogiad meditsiinitehnikas

Uurimisrühma juht: Ivo Fridolin, professor, 620 2206, Ivo.Fridolin@taltech.ee

Liikmed:

Jürgen Arund, vanemteadur;
Jana Holmar, vanemteadur;
Merike Luman, vanemteadur;
Kristjan Pilt, vanemteadur;
Risto Tanner, vanemteadur;
Nils Fredrik Arne Uhlin, vanemteadur;
Moonika Viigimäe, teadur;
Joosep Paats, doktorant-nooremteadur;
Ardo Allik, doktorant, insener;
Andrus Paats, doktorant;
Deniss Karai, insener.

Võtmesõnad:

Sensorid, algoritmid, sensorite integratsioon, biovedelike optika, ureemilised toksiinid, dialüüsravi, reaajas monitooring, spektrofotomeetria, spektrofluorimeetria, signaalitöötlus, tark tööriivas, füüsilise aktiivsuse monitooring, energiakulu, väsimuse monitooring, kõnetuvastus

Kompetents

Uurimisgrupi teadustöö eesmärgiks on välja töötada paindlikke ja uudseid sensortehnoloogiaid ja algoritme:

1. Ureemiliste toksiinide eemaldamise jälgimiseks reaajas. Mõõdetud parameetrid võimaldavad hinnata erinevate ureemiliste toksiinide kontsentratsioone reaajas ilma vereproove võtmata ning seega aitab saada paremini tagasisidet ravi (n neeruasendusravi) kohta ning kohandada raviviise vastavalt patsientide vajadustega.
2. Isikustatud ja targa tööriiva loomiseks, mis tööriivasse integreeritud sensorite ja uudsete algoritmide abil looks väärtuslikke andmeid tööliste asukohast, kõnnimustritest, füüsilisest aktiivsusest, energiakulust ja füsioloogilisest seisundist ning parandaks tehnoloogiliste lahenduste ja teenuste abil teadlikkust ja ohutust nõudlikes ja ohtlikes töökeskkondades.
3. Uuenduslike psühhoфизиoloogiliste meetodite väljatöötamine, mis ühendab kvantitatiivseid füsioloogilisi ja subjektiivseid psühholoogilisi näitajaid, et hinnata inimeste emotsionaalset vastust erinevatele (elu)keskkondadele (n turvalised, mugavad, stressirohked, ülestimuleerivad või ebaatraktiivsed). Üks rakendusvaldkond on ületada lõhe linnaplaneerijate ja linnaelanike vahel kasutades nn heaoluskooi kaardistamist.

Osalemine projektides

- TAR16013 (EXCITE) "IT Tippkeskus EXCITE (2016–2023)", PI M. Kruusmaa;
- AR20013 „Targa linna tippkeskus“ (2022-2023), PI Ralf-Martin Soe.

Teaduspublikatsioonid (valik)

- Adoberg, A.; Paats, J.; Arund, J.; Dhondt, A.; Fridolin, I.; Glorieux, G.; Holmar, J.; Lauri, K.; Leis, L.; Luman, M.; Pilt, K.; Uhlin, F.; Tanner, R. Treatment with Paracetamol Can Interfere with the Intradialytic Optical Estimation in Spent Dialysate of Uric Acid but Not of Indoxyl Sulfate. (2022) Toxins, 14 (9), #610. DOI: 10.3390/toxins14090610.
- Allik, A.; Pilt, K.; Viigimäe, Mo.; Fridolin, I.; Jervan, G. A Novel Physical Fatigue Assessment Method Utilizing Heart Rate Variability and Pulse Arrival Time towards Personalized Feedback with Wearable Sensors (2022) Sensors, 22 (4), #1680. DOI: 10.3390/s22041680.

Rahvusvahelisel tasemel väljapaistvad teadustulemused

Esmakordselt õnnestus rahvusvahelise teadusuuringu tulemusena näidata, kui suur on UV-kiirgust neelavate ravimite, nagu paratsetamool (Par), manustamise mõju ureemiliste toksiinide kusihaape (UA) ja indoksülsulfaadi (IS) eemaldamise optilise seire täpsusele standardisel hemodialüüsravil (HD) ja hemodiafiltratsiooniravil (HDF). Samuti on uudsed tulemused, mis heidavad valgust kolme teise hemodialüüsiga seoses tavapäraselt kasutatava kromofoorse ravimi (ampitsilliin, flukloksatsilliin ja valatsükloviir) mõju kohta. Katsetulemuste analüüsi põhjal tehti järeldus, et ravimid katsete käigus manustatud annustes ei mõjuta neeruasendusravi optilise seire täpsust. Ülaltoodud tulemused annavad medikutele kindlustunde, et hemodiafiltratsiooniravil ravimite mõju optilise hemodialüüsi monitooringu täpsusele ei ilmne ja hemodialüüsravil on mõju väike. Lisaks loob teadusartikkel soodsa pinnase laialdasemaks TalTechi teadlaste poolt väljatöötatud ureemiliste jääkainete optilise monitooringumeetodi kasutamiseks kliinilises praktikas.

Uurimisrühma veebilehe aadress

<https://taltech.ee/biomeditsiinitehnika-keskus>

Uurimisrühma seotus TalTech TA prioriteetse suunaga

Tervisetehnoloogiad

Tegevusvaldkond

- | | |
|---------------------------|----------------------------------|
| 1. Loodusteadused | 1.2 Arvutiteadus ja informaatika |
| 2. Tehnika ja tehnoloogia | 2.6 Meditsiinitehnika |

Teaduseriala

T115 Meditsiinitehnika
B140 Kliiniline füüsika, radioloogia, tomograafia, meditsiinitehnika
T121 Signaalitöötlus

Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös

Ivo Fridolin on rahvusvahelise *European Uremic Toxin Work Group* (EUTox WG) liige.

Rakendused ettevõtluses, majanduses, ühiskonnas

- European Union through the European Regional Development Fund H2020-SMEINST-2-2017, OLDIAS2— Online Dialysis Sensor Phase2 project, Grant Agreement nr 767572. (2017-2019)
- Online Dialysis Sensor Pilot Study, contract research, Optofluid Technologies OÜ and Fresenius Medical Care Deutschland GmbH, 2021-2022.

Käimasolevate projektide/lepingute tulemuste rakendusvõimalused.

Tervishoius. Tööohutuses. Linnaplaneerimises.

Olulisemad koostööpartnerid

Välispartnerid:

Nephrology Division, Ghent University Hospital, Ghent, Belgium
Department of Nephrology and Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden
Fundación Jiménez Díaz University Hospital Health Research Institute, Madrid, Spain

Eesti koostööpartnerid:

Narva Linnavalitsuse Arhitektuuri ja Linnaplaneerimise Amet
Põhja-Eesti Regionaalhaigla Nefroloogiakeskus
Optofluid Technologies OÜ

Hüpertensiooni ja ateroskleroosi diagnostika ning ravi tehnoloogiate uurimisgrupp

Uurimisrühma juht: Margus Viigimaa, professor, margus.viigimaa@taltech.ee

Liikmed:

Kalju Meigas, emeriitprofessor;

Sergei Nazarenko, praktik-professor;

Tiina Titma, teadur;

Grete Talviste, doktorant.

Võtmesõnad: hüpertensioon, ateroskleroos, tehnoloogiad, diagnoosimine, ravi.

Kompetents

- Südame- ja veresoonte haiguste diagnostika ja ravi tehnoloogiate uurimine ja rakendamine;
- südame - veresoonekonna haigustega seotud teaduslikes uuringutes kasutatavate insenerilahenduste juurutamine meditsiini;
- uute kardiovaskulaarmeditsiini tehnoloogiate väljatöötamine ja kliiniline rakendamine;
- varajase ateroskleroosi määramise uuringud ja seadmete juurutamine;
- resistentse hüpertensiooni hemodünaamika uuringud ja innovatiivsete ravijuhtimise meetodite väljatöötamine;
- kardiovaskulaarse riski (koos geeniriskiga) määramise ja langetamise uuringud;
- perekondliku hüperkolesteroleemia diagnoosimise ja ravi uuringud.

Osalemine projektides

Uurimisrühm osaleb TalTechi ning SA Põhja-Eesti Regionaalhaigla vahel sõlmitud projektis „Perekondliku hüperkolesteroleemia diagnoosimise ja ravi uute tehnoloogiate väljatöötamine“. Uurimistöo on suunatud perekondliku hüperkolesteroleemia patsientide arterite ateroskleroosiliste muutuste mitteinvasiivsele diagnoosimise ja uute ravimeetodite kliiniline rakendamisele.

Personaarmeditsiini kliinilises juhtprojektis südame-veresoonekonna haiguste täppisennetuses (RITA1/01-42) uurisime personaarmeditsiini rakendatavust südame-veresoonekonna haiguste preventioonis. Projekti juht ja publikatsiooni esimene autor oli professor M. Viigimaa.

Osaleme projekti F21009 "Universaalse andmemudeli ja raviteekondade järjepidevuse standardi väljatöötamine lähtudes rahvusvahelisest uue põlvkonna terviseinfosüsteemide standarditest" (1.02.2021–30.04.2024); Vastutav täitja: Peeter Ross; Tallinna Tehnikaülikool, Infotehnoloogia teaduskond, Tervisetehnoloogiate instituut (partner); Finantseerija: Norway Grants Programme "Green ICT".

Teaduspublikatsioonid (valik)

1. Viigimaa M, Jürisson M, Pisarev H, Kalda R, et al. Effectiveness and feasibility of cardiovascular disease personalized prevention on high polygenic risk score subjects: a randomized controlled pilot study. *Eur Heart J Open* 2022; 2, 1–10. <https://doi.org/10.1093/ehjopen/oeac079>
2. Hagström E, Steg PG, Szarek M, Bhatt DL, Bittner VA, et al (incl Viigimaa M). Apolipoprotein B, Residual Cardiovascular Risk After Acute Coronary Syndrome, and Effects of Alirocumab. *Circulation*. 2022 Aug 30;146(9):657-672. doi: 10.1161/CIRCULATIONAHA.121.057807
3. Banach M, Reiner Z, Cicero AFG, Sabouret P, Viigimaa M, et al. 2022: the year in cardiovascular disease - the year of upfront lipid lowering combination therapy. *Arch Med Sci*. 2022 Nov 7;18(6):1429-1434. doi: 10.5114/aoms/156147. eCollection 2022.
4. Serg M, Tsvetkov E, Sepp A, Viigimaa. Düslipideemia müokardiinfarktiga patsientidel – multidistsiplinaarne analüüs. *Lege Artis* 2022; 5(6)/2022, 45–49.
5. Penson PE, Bruckert E, Marais D, Reiner Ž, et al (incl Viigimaa M). Step-by-step diagnosis and management of the nocebo/drucebo effect in statin-associated muscle symptoms patients: a position paper from the International Lipid Expert Panel (ILEP). *J Cachexia Sarcopenia Muscle*. 2022 Jun;13(3):1596-1622. doi: 10.1002/jcsm.12960.
6. Graham, R., Moreira, A.P., Glaudemans, A.W.J.M. et al. (incl Nazarenko S). 2022 follow-up: impact of the COVID-19 pandemic on nuclear medicine departments in Europe. *Eur J Nucl Med Mol Imaging* 49, 3309–3315 (2022). <https://doi.org/10.1007/s00259-022-05881-y>.

Rahvusvahelisel tasemel väljapaistvad teadustulemused

Uurimisrühm osaleb European Atherosclerosis Society International Lipid Expert Panel (ILEP). Artikkel "Step-by-step diagnosis and management of the nocebo/drucebo effect in statin-associated muscle symptoms patients: a position paper from the International Lipid Expert Panel" avaldati J Cachexia Sarcopenia Muscle. 2022 Jun;13(3):1596-1622. doi: 10.1002/jcsm.12960. Uurimisrühm kuulub ka Euroopa Hüpertensiooniühingu Eksellentsikeskuse hulka.

Kõrgetasemeliste publikatsioonide (1.1.) arv aastal 2022 on 5.

Uurimisrühma seotus TalTech TA prioriteetse suunaga

Tervisetehnoloogiad

Tegevusvaldkond

3.2. Kliiniline meditsiin

3.3. Terviseteadused

Teaduseriala

B530 Südame-veresoonkonna haigused

E-tervise rakenduste ja teenuste uurimisgrupp

Uurimisrühma juht: Peeter Ross, professor, tel 5635 3460 peeter.ross@taltech.ee

Liikmed:

Katrin Gross-Paju, vanemteadur;
Madis Tiik, vanemlektor;
Barbara Haage, lektor;
Riina Hallik, lektor;
Kerli Linna, lektor;
Hany Gergis Moawad Mina, lektor;
Priit Kruus, lektor, doktorant;
Kadi Lubi, teadur;
Igor Bossenko, doktorant-nooremteadur;
Kristian Juha Ismo Kankiainen, doktorant-nooremteadur;
Marten Kask, doktorant-nooremteadur;
Toomas Klementi, doktorant-nooremteadur;
Olga Vovk, doktorant-nooremteadur;
Markus Bertl, doktorant;
Riin Ehin, doktorant
Janek Metsallik, e-tervise spetsialist, doktorant;
Carmen Mäe, e-tervise analüütik;
Kerli Norak, e-tervise analüütik;
Hedvig Soone, e-tervise analüütik;
Liis Hamburg, projektijuht;
Maarja Kuslapuu, projektijuht;
Mall Maasik, projektijuht;
Kerli Luks, tervishoiu spetsialist;
Tanel Ross, tervishoiu spetsialist;
Helen Staak, õppekava kommunikatsiooni spetsialist.

Võtmesõnad: Tervishoiu digitaliseerimine, digitervis, muutuste juhtimine tervishoius, e-tervis, digitaalsete tervisetehnoloogiate hindamine

Kompetents

2022. aastal uusi kompetentse keskusesse ei lisandunud. Uurimisrühma spetsiifilise tegevus on endiselt seotud meditsiinis ja tervishoius kasutatavate digitaalsete andmete kvaliteedi, arhitektuuri ja andmemudelitega, digitaalsete tervisetehnoloogiate hindamise ja kasutusvaldkondadega ning digitervise lahenduste õpetamisega arstidele ja õdedele. Samuti jätkus personaalmeditsiiniga seonduvate infotehnoloogiliste lahenduste uurimine.

Keskuse põhitegevused

2022. aasta oli suuresti mõjutatud koroonapandeemiast taastumisest. Taas sai võimalikuks füüsiliselt keskuse ruumides viibimine ja kontaktõpe. Kahjuks jättis koroonapandeemia aeg olulise tühiku uute projektide saamisel. Ehkki uurimistöö tegemine jätkus valdkondades, mis käsitlevad terviseandmete mudeleid, kliinilisi otsustustugesid, digitaalsete tervisetehnoloogiate hindamist, inimese terviseandmetega seonduvat käitumist veebis ning tervishoiu digitaliseerimise komponente ja tegureid, ei lisandunud uusi projekte ega uurimissuundi.

Digital Health magistriprogrammi õppe läbiviimine, projektide ja tellimustööde teostamine ning projektitaotluste ja pakkumuste kirjutamine olid endiselt keskuse töö fookuses.

2021. aastal toimus keskuse teadustöö järgmiste projektide või tellimustööde raames:

- Digitervise lahenduste tasustamist toetav raamistik ja ettepanekud (Eesti Haigekassa);
- Perearstide digitaalse kirjaoskuse tõstmise koolitus (Majandus- ja Kommunikatsiooniministeerium);
- 7 doktorandi uurimisteemad digitervise erinevates valdkondades.

Osalemine projektides

- Pearingstide digitaalse kirjaoskuse tõstmise koolitus;
- HealthSense. Universaalse andmemudeli ja raviteekondade järjepidevuse standardi väljatöötamine lähtudes rahvusvahelistest uue põlvkonna terviseinfosüsteemide standarditest Norway Grants Programme "Green ICT"(Norway Grants Programme "Green ICT");
- Kaugteenuste näidisprojektide protsessi analüüs Eesti Haigekassale (Eesti Haigekassa);
- NORDeHEALTH Põhjamaade e-tervis patsientidele: võrdlusuuringud ja arendustööd tulevikuks (Eesti Teadusagentuur);
- Rinnavähi polügeense riskiskoori arvutuse ja farmakogeneetika tänaste tarkvaraliste meditsiiniseadmete turuanalüüs Tervise Arengu Instituudile;
- Kliiniliste otsuste tugisüsteemide turuanalüüs Eesti Haigekassale.

Olulisemad artiklid:

- Korv, Janika; Antsov, Katrin; Gross-Paju, Katrin; Kalju, Inga; Kreis, Andrus; Liigant, Aive; Vibo, Riina (2022). Developments in quality of stroke care in Estonia. *European Stroke Journal*, 1–9. DOI: 10.1177/23969873221110745.
- Bertl, Markus; Ross, Peeter; Draheim, Dirk (2022). A survey on AI and decision support systems in psychiatry – uncovering a dilemma. *Expert Systems with Applications*, 202, 117464–14 pp. DOI: 10.1016/j.eswa.2022.117464.

Magistriprogrammi planeerimine ja koordineerimine ning magistritööde juhendamine kulges ilmselt koroonapandeemiast mõjutatuna keeruliselt, mille väljenduseks oli suhteliselt väike kaitstud tööde arv. Samas on endiselt õppesse soovijate hulk suurem, kui planeeritud 25 kohta, mis tähendab, et huvi tervishoiutehnoloogiat õppida on olemas. E-mediitsiini keskuses tegelesid oma teadustööga 2021. aastal 8 doktoranti.

Meie keskuse töötajad olid rahvusvaheliselt aktiivsed: erinevatel veebivahendusel läbi viidud üritustel tehti mitukümmend ettekannet. Meil on koostöö Põhjamaade ülikoolidega, Flensburgi ja Regensburgi rakenduskõrgkooliga ning paljude teistega. Samuti on meil tihe koostöö Eesti digiterwise valdkonna iduettevõtetega, ITK, LTKH, PERH-i, Haigekassa, TEHIK-u, Geenivaramu ja IT ettevõtetega.

Uute projektide puudumisel ja olemasolevate projektide järkjärgulise lõppemise tõttu tuli E-mediitsiini keskuse töötajate hulka vähendada. Aasta lõpuks lahkus keskusest 5 töötajat ja mitmel töötajal tuli koormust vähendada. Meie keskuses oli 2022. aasta lõpuks tööl 14 akadeemilist töötajat. Lisaks oli meie vastutusel oleva 12 õppeaine läbi viimiseks käsunduslepingud paljude (ligi 20) spetsialistidega.

Keskuse õppe-, arendus- ja teadustöö toimub väga huvitavas valdkonnas – digitervis/e-tervis – mis on jätkuvalt aktuaalne valdkond kogu maailmas. See annab positiivse tausta meie keskuse töötajatele. E-mediitsiini keskuse eelarve eelmisel aastal oluliselt ei muutunud, kuid 2023. aasta eelarve jääb ilmselt oluliselt väiksemaks.

Keskuse eripäraks on tihe seotus praktilise valdkonna tööga. Valdav enamus akadeemilistest töötajatest on ametis ka valdkonna ettevõtetes ja organisatsioonides. Õppetööga paralleelselt valdkonna ettevõtetes töötamine annab väga palju juurde õpetamise sisule ja võimaldab õpetada reaalselt elus vaja minevaid oskusi.

Uurimisrühma seotus TalTech TA prioriteetse suunaga

- Tervisetehnoloogiad
- Usaldusväärsed IT-lahendused

Tegevusvaldkond

- 3. Arsti- ja terviseteadused 3.3 Terviseteadused
- 3. Arsti- ja terviseteadused 3.4 Meditsiiniline biotehnoloogia

Teaduseriala

T115 Meditsiinitehnika

Osalemine oluliste TA&I-ga seotud välisorganisatsioonide töös

Kaks keskuse töötajat on Maailmapanga ning üks Aasia Arengupanga ja Saksa Arengupanga KfW konsultandid digiterwise valdkonnas.

Info uurimisrühma rakendusliku väljundiga teadus- ja arendustegevuses

E-mediitsiini keskus on saanud rahastuse järgmiseks aastaks kahele rahvusvahelisele projektile:

- HealthSense. In cooperation with Health and Welfare Information System Center and Software Technology and Applications Competence Centre (STACC).
- Nordic eHealth for Patients: Benchmarking and Developing for the Future (NordForsk). The consortium includes 4 universities from Sweden and 1 university from Finland, Norway and USA.

DEPARTMENT OF HEALTH TECHNOLOGIES

Most important success stories of Health Technologies department in 2022

1. [Organizing the conference of the Estonian Center of Excellence in ICT Research "Future belongs to the curious"](https://onlineexpo.com/ee/excite-konverents/conference/) (Prof. Fridolin CoE EXCITE coordinator and one of the main presentators), Proto avastustehas, Nobeli hall, Tallinn, Estonia, 9.03.2022, <https://onlineexpo.com/ee/excite-konverents/conference/>; and <https://www.youtube.com/watch?v=Nw8suH02FAC>

The EXCITE Center of Excellence has brought together the absolute best of the Estonian IT-sector. EXCITE researchers use scientific methods to develop secure and reliable ICT systems, deploying them wherever possible - with the focus areas such as healthcare, safety, environmental protection, banking and more.

The future belongs to the ones who are not afraid to try it, explore and question it - to turn it inside out. Tallinn University of Technology, University of Tartu and AS Cybernetica invite you to the EXCITE conference on 9 March 2022 at Proto Avastustehas Nobel hall. Together we look at the future and formulate the challenges and goals of the next year in the field of IT, that the Estonian e-tiger could start striving for. The conference was moderated by Johannes Tralla. The conference was in Estonian with simultaneous translation into English. See also_ENG - https://issuu.com/erilahendused/docs/excite_2021_eng (Estonian Centre of Excellence in ICT Research EXCITE special issue "Estonian Centre of Excellence in ICT Research EXCITE", Ekspress Meedia AS Erilahenduste osakond)

2. Start of the FinEst Centre for Smart Cities „Urban Planning Well-being Score for Good Quality Living Environment“ pilot project. <https://www.finestcentre.eu/urban-planning-well-being-score-oct22>

See also: <https://www.finestcentre.eu/wellbeingscore> and <https://www.finestcentre.eu/pilotingprogrammes>

3. From March 2020 to October 2022, the e-Medicine Centre of the Department of Health Technologies conducted "Digital skills development training for family doctors and nurses" within the framework of the training procurement of the Ministry of Economic Affairs and Communications, which was attended by 500 people, 60% of whom were doctors and 40% were family nurses. The training reached every county in Estonia. Based on the feedback of the participants, they liked the future-oriented view used in everyday work the most, and the topics covered in the training raised new questions, which is why follow-up trainings are also expected.

The project was financed by the support scheme of the European Social Fund "Increasing digital literacy".

Brain bioelectrical signals research group

Group leader: Maie Bachmann, Professor, +372 620 2202, maie.bachmann@taltech.ee

Members:

Hiie Hinrikus, Senior Research Scientist, Professor Emeritus;

Jaanus Lass, Senior Research Scientist;

Laura Päeske, Researcher;

Tuuli Uudeberg, Early Stage Researcher, PhD student;

Marietta Gavriljuk, Specialist.

Key words: signal processing, electroencephalography, brain disorders (e.g. depression)

Competency

The research group is experienced in the interdisciplinary area of information technology and brain physiology. The studies are aimed to detect and interpret the features in the brain electroencephalography (EEG) signal characteristic for mental disorder (e.g. depression), occupational and/or environmental stressors comprising the advanced methods of signal analysis and the knowledge about brain neuronal activity. An original Spectral Asymmetry Index (SASI) has been developed and proved as a promising method in various applications.

Participation in the following significant projects

- TAR16013 (EXCITE) "Estonian Centre of Excellence in ICT Research (2016–2023)", PI M. Kruusmaa;
- 5GEMF1 "Assessment of current and 5G caused possible health effects related to nonionizing radiation" (2021-2022), PI M. Bachmann;
- AR20013 „Targa linna tippkeskus“ (2022-2023), PI R-M Soe;
- COST Action CA19127 Cognitive decline in Nephro-Neurology: European Cooperative Target (2020-2024);
- COST Action CA18106 The neural architecture of consciousness (2019-2023).

Selected publications

- Hinrikus, H. et al. (2022) Limiting exposure to radiofrequency radiation: the principles and possible criteria for health protection, International Journal of Radiation Biology, DOI: 10.1080/09553002.2023.2159567
- Uudeberg, T. et al. (2022) Changes in EEG Measures of a Recipient of the mRNA COVID-19 Vaccine - A Case Study. 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Glasgow, Scotland, United Kingdom, 2022, pp. 3702-3705, doi: 10.1109/EMBC48229.2022.9871524.
- Pépin, M. et al. (2022). Cognitive disorders in patients with chronic kidney disease: specificities of clinical assessment. Nephrology Dialysis Transplantation. DOI: 10.1093/ndt/gfab262.

Main results

- by applying EEG-based objective measures it is feasible to detect the changes and recovery caused by mRNA COVID-19 vaccine;
- there is no threshold for the biological or health effects of radio frequency radiation, while the health risk can be minimized by linking the health protection limit values to the level of radiation, in which no significant health effects have been noticed during a long period of exposure (6 V/m).

Website address of the research group

<https://taltech.ee/en/biosignal-processing-laboratory>

TalTech R&D priority areas

- Health Technologies
- Dependable IT solutions

Field of research

1.2 Computer and information sciences

2.6 Medical engineering

CERCS classification

T115 Medical technology

T121 Signal processing

Participation of the research group members in the activities of international R&D organizations, membership of foreign academies in 2022

COST Action CA19127 Maie Bachmann, member of the Management Committee

COST Action CA18106 Maie Bachmann, member of the Management Committee

International Academy for Medical and Biological Engineering (IAMBE), Hiie Hinrikus, fellow

European Alliance for Medical and Biological Engineering and Science (EAMBES) Hiie Hinrikus, fellow

The results of the ongoing projects can be applied to

- Healthcare
- Occupational safety
- City planning

Most important foreign and Estonian cooperation partners

Foreign:

Nalecz Institute of Biocybernetics and Biomedical Engineering Polish Academy of Sciences, Warsaw, Poland

Laboratory for Human Brain Dynamics, AAI Scientific Cultural Services Ltd., Nicosia, Cyprus

French National Institute for Industrial Environment and Risks (INERIS), France

Estonia:

Qvalitas Medical Centre

North Estonia Medical Centre

Narva City

Sensor technologies in biomedical engineering (SensorTechBME) research group

Group leader: Ivo Fridolin, Professor, +372 620 2206 ivo.fridolin@taltech.ee

Members:

Jürgen Arund, Senior Research Scientist;

Jana Holmar, Senior Research Scientist;

Merike Luman, Senior Research Scientist;

Kristjan Pilt, Senior Research Scientist,

Risto Tanner, Senior Research Scientist;

Nils Fredrik Arne Uhlín, Senior Research Scientist;

Moonika Viigimäe, Researcher;

Joosep Paats, Early Stage Researcher;

Ardo Allik, Engineer, PhD student;

Andrus Paats, PhD student;

Deniss Karai, Engineer.

Key words: Sensors, algorithms, sensor fusion, biofluid optics, uremic toxins, dialysis, on-line monitoring, spectrophotometry, spectrofluorimetry, signal processing, smart work wear, physical activity monitoring, energy consumption, fatigue monitoring, automatic speech recognition, speech-to-text applications.

Competency

The main research field of the SensorTechBME team is to develop flexible and novel sensor technologies and algorithms in biomedical engineering applications:

1. to estimate dialysis adequacy and quality securing end stage renal disease (ESRD) patients' care quality. The research is exploring spectrophotometrical and spectrofluorimetric characteristics-signatures of the biofluids and performing various signal processing and analysis on those signals.
2. to develop beyond the state-of-the-art applications incorporated into a smart wearable multi-sensor fusion system for generating valuable data about the workers' location, locomotion, physical activity, energy consumption and physiological status;
3. for speech-to-text usage in healthcare and industry.

Participation in the following significant projects

- TAR16013 (EXCITE) "Estonian Centre of Excellence in ICT Research (2016–2023)", PI M. Kruusmaa;
- AR20013 „Targa linna tippkeskus“ (2022-2023), PI R-M Soe.

Selected publications

- Adoberg, A.; Paats, J.; Arund, J.; Dhondt, A.; Fridolin, I.; Glorieux, G.; Holmar, J.; Lauri, K.; Leis, L.; Luman, M.; Pilt, K.; Uhlín, F.; Tanner, R. Treatment with Paracetamol Can Interfere with the Intradialytic Optical Estimation in Spent Dialysate of Uric Acid but Not of Indoxyl Sulfate. (2022) *Toxins*, 14 (9), #610. DOI: 10.3390/toxins14090610.
- Allik, A.; Pilt, K.; Viigimäe, Mo.; Fridolin, I.; Jervan, G. A Novel Physical Fatigue Assessment Method Utilizing Heart Rate Variability and Pulse Arrival Time towards Personalized Feedback with Wearable Sensors (2022) *Sensors*, 22 (4), #1680. DOI: 10.3390/s22041680.

Outstanding (internationally recognized) research results of the research group for the past year.

For the first time, as a result of an international research study, it was possible to show the effect of the administration of UV-absorbing drugs such as paracetamol (Par) on the accuracy of optical monitoring of the removal of uremic toxins uric acid (UA) and indoxyl sulfate (IS) during standard hemodialysis (HD) and hemodiafiltration (HDF) treatment. There are also novel results that shed light on the effects of three other chromophoric drugs commonly used in hemodialysis (ampicillin, flucloxacillin, and valacyclovir). Based on

the analysis of the test results, it was concluded that the drugs in the doses administered during the tests do not affect the accuracy of the optical monitoring of renal replacement therapy.

The above results give medics confidence that the effect of drugs on the accuracy of optical hemodialysis monitoring is not evident during hemodiafiltration treatment, and the effect is small during hemodialysis treatment. In addition, the research article creates a favorable ground for the wider use of the optical monitoring method of uremic residues developed by TalTech researchers in clinical practice.

Website address of the research group

<https://taltech.ee/en/centre-biomedical-engineering>

TalTech R&D priority areas

Health technologies

Field of research

- | | |
|-------------------------------|---------------------------------------|
| 1. Natural Sciences | 1.2 Computer and information sciences |
| 2. Engineering and technology | 2.6 Medical engineering |

CERCS classification

T115 Medical technology

B140 Clinical physics, radiology, tomography, medical instrumentation

T121 Signal processing

Organizational activity

- I. Fridolin is a member of the international European Uremic Toxin Work Group (EUTox WG).

Information on applied research and development activities of the research group

- European Union through the European Regional Development Fund H2020-SMEINST-2-2017, OLDIAS2—Online Dialysis Sensor Phase2 project, Grant Agreement nr 767572. (2017-2019)
- Online Dialysis Sensor Pilot Study, contract research, Optofluid Technologies OÜ and Fresenius Medical Care Deutschland GmbH, 2021-2022.

The results of ongoing projects/contracts can be applied

- Healthcare
- Work safety
- Urban Planning

Most important foreign and Estonian cooperation partners

Foreign:

- Nephrology Division, Ghent University Hospital, Ghent, Belgium;
- Department of Nephrology and Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden;
- Fundación Jiménez Díaz University Hospital Health Research Institute, Madrid, Spain.

Estonia:

- Narva City Government, Architecture and Urban Planning Department;
- Centre of Nephrology at North Estonia Medical Centre;
- Optofluid Technologies OÜ.

Research group on diagnostics and treatment technologies of hypertension and atherosclerosis

Group leader: Margus Viigimaa, Professor, margus.viigimaa@taltech.ee

Members:

Kalju Meigas, Professor Emeritus;

Sergei Nazarenko, Professor of Practice;

Tiina Titma, Researcher;

Grete Talviste, PhD student.

Key words: hypertension, atherosclerosis, technologies, diagnosis, treatment

Competency

- Research and development of novel technologies in cardiovascular medicine
- Development of the cardiovascular medical engineering
- Clinical application of novel technologies in the field of cardiovascular medicine
- Early atherosclerosis and development of novel technologies and devices
- Hemodynamics of resistant hypertension and development of novel methods in guiding of drug treatment
- Cardiovascular risk assessment (including polygenic risk score) and management
- Diagnosis and treatment of familial hypercholesterolemia

Participation in the following significant projects

The group members participate in the joint research project with the North Estonia Medical Centre "Novel technologies in the diagnostics and treatment of familial hypercholesterolemia".

RITA1/01-42-02 "Clinical pilot projects of personalised medicine in the precise prevention of breast cancer and cardiovascular diseases" results were analysed and published in the Eur Heart J Open.

We are also participating in the project F21009 "Development of universal data model and continuity of care processes based on international standards for new generation health information systems"

Norway Grants Programme "Green ICT".

Selected publications

7. Viigimaa M, Jürisson M, Pisarev H, Kalda R, et al. Effectiveness and feasibility of cardiovascular disease personalized prevention on high polygenic risk score subjects: a randomized controlled pilot study. *Eur Heart J Open* 2022; 2, 1–10. <https://doi.org/10.1093/ehjopen/oeac079>
8. Hagström E, Steg PG, Szarek M, Bhatt DL, Bittner VA, et al (incl Viigimaa M). Apolipoprotein B, Residual Cardiovascular Risk After Acute Coronary Syndrome, and Effects of Alirocumab. *Circulation*. 2022 Aug 30;146(9):657-672. doi: 10.1161/CIRCULATIONAHA.121.057807
9. Banach M, Reiner Z, Cicero AFG, Sabouret P, Viigimaa M, et al. 2022: the year in cardiovascular disease - the year of upfront lipid lowering combination therapy. *Arch Med Sci*. 2022 Nov 7;18(6):1429-1434. doi: 10.5114/aoms/156147. eCollection 2022.
10. Serg M, Tsvetkov E, Sepp A, Viigimaa. Düslipeemia müokardiinfarktiga patsientidel – multidistsiplinaarne analüüs. *Lege Artis* 2022; 5(6)/2022, 45–49.
11. Penson PE, Bruckert E, Marais D, Reiner Ž, et al (incl Viigimaa M). Step-by-step diagnosis and management of the nocebo/drucebo effect in statin-associated muscle symptoms patients: a position paper from the International Lipid Expert Panel (ILEP). *J Cachexia Sarcopenia Muscle*. 2022 Jun;13(3):1596-1622. doi: 10.1002/jcsm.12960.
12. Graham, R., Moreira, A.P., Glaudemans, A.W.J.M. et al. (Incl Nazarenko S). 2022 follow-up: impact of the COVID-19 pandemic on nuclear medicine departments in Europe. *Eur J Nucl Med Mol Imaging* 49, 3309–3315 (2022). <https://doi.org/10.1007/s00259-022-05881-y>.

Internationally recognised research results

The group is participating in the European Atherosclerosis Society International Lipid Expert Panel (ILEP). The paper “Step-by-step diagnosis and management of the nocebo/drucebo effect in statin-associated muscle symptoms patients: a position paper from the International Lipid Expert Panel” was published in the J Cachexia Sarcopenia Muscle. 2022 Jun;13(3):1596-1622. doi: 10.1002/jcsm.12960. The group is also among the Excellence centers of the European Society of Hypertension.

The number of 1.1. publications in 2022 is 5.

TalTech R&D priority areas

Health technologies

Fields of research

3.2 Clinical medicine

3.3 Health sciences

CERCS classification

B530 – Cardiovascular system

Digital health applications and services

Group leader: Peeter Ross, Professor, +372 5635 3460 peeter.ross@taltech.ee

Members:

Katrin Gross-Paju, Senior Research Scientist;

Madis Tiik, Senior Lecturer;

Barbara Haage, Lecturer;

Riina Hallik, Lecturer;

Kerli Linna, Lecturer;

Hany Gergis Moawad Mina Lecturer;

Priit Kruus, Lecturer, PhD student;

Kadi Lubi, Researcher;

Igor Bossenko, Early Stage Researcher;

Kristian Juha Ismo Kankiainen, Early Stage Researcher;

Marten Kask, Early Stage Researcher;

Toomas Klementi, Early Stage Researcher;

Olga Vovk, Early Stage Researcher;

Markus Bertl, PhD student;

Riin Ehin, PhD student.

Janek Metsallik, Expert of E-Health, Phd student;

Carmen Mäe, E-Health Analyst;

Kerli Norak, E-Health Analyst;

Hedvig Soone, E-Health Analyst;

Liis Hamburg, Project Manager;

Maarja Kuslapuu, Project Manager;

Mall Maasik, Project Manager;

Kerli Luks, Health Care Specialist;

Tanel Ross, Health Care Specialist;

Helen Staak, Study Programme Communication Officer.

Key words: Digital health, eHealth, change management in health care

Competency

The core competencies of the research group are the development of IT solutions related to digitalization of health care (e-health) and research of the interoperability factors necessary for their implementation. Factors to be studied include strategies, standards, IT architecture, data statuses and databases used for large (national or regional) e-health systems. In 2022, the research team's more specific activities were related to the medical and health care digital data quality, architecture and models, evaluation and use of digital health technologies and digital health education for doctors and nurses. Also, the development and research of IT solutions related to personal medicine. There were not new competency areas that have been added to the eMed Lab in 2022.

Main Activities of the eMed Lab in 2022

The activities of eMed Lab were strongly influenced by the recovering from corona pandemics. It was again possible to stay physically in lab premises and have face-to-face teaching. Unfortunately, as a consequence of pandemics, there were no successful applications of new projects.

The main activities in 2022 were conducting research in areas of digital health data models, clinical decision support systems, evaluation of digital health technologies, user behavior concerning web-based health and medical data access, and components and factors for digitizing healthcare. Participation and presentations in various international research and development projects. Conducting a Master's Program in Health Care Technology. Projects' management and writing new projects applications and tenders proposals. In 2022, the Center carried out research on the following projects and contracts:

- Framework and proposals supporting the reimbursement of digital health solutions (Estonian Health Insurance Fund);

- Digital literacy training for GPs (Ministry of Economic Affairs and Communications);
- Research topics of 7 doctoral students in the field of digital health.

Participation in the following significant projects

- In-service training in digital literacy for family doctors and nurses;
- Development of a universal data model and continuity of care processes based on international standards for new-generation health information systems;
- Process analysis of innovation competition of remote services to Estonian Health Insurance Fund Nordic eHealth for Patients: Benchmarking and Developing for the Future;
- Market analysis of software solutions for polygenic risk score calculations and pharmacogenetics of breast cancer for the National Institute for Health Development
- Market analysis of commercially available Digital Decision Support Systems for the Estonian Health Insurance Fund.

Selected publications

- Korv, Janika; Antsov, Katrin; Gross-Paju, Katrin; Kalju, Inga; Kreis, Andrus; Liigant, Aive; Vibo, Riina (2022). Developments in quality of stroke care in Estonia. *European Stroke Journal*, 1–9. DOI: 10.1177/23969873221110745.
- Bertl, Markus; Ross, Peeter; Draheim, Dirk (2022). A survey on AI and decision support systems in psychiatry – uncovering a dilemma. *Expert Systems with Applications*, 202, 117464–14 pp. DOI: 10.1016/j.eswa.2022.117464.

Planning and coordinating the Master's program and supervising Master's theses was complicated because of the influence of corona pandemic. The number of graduates was relatively low. The team leader of the program is Kadi Lubi. However, the number of people wishing to study is still higher than 25 students, which means that people are interested in learning about digital health.

In 2022, 8 PhD students worked in the eMedLab.

Our center's staff was active internationally: in several web-based events, several presentations were made. We cooperate with universities of Nordic countries, several Finnish research and development institutions, the University of Applied Sciences in Flensburg and Regensburg, and many others. We also have close cooperation with Estonian start-ups in the field of digital health, as well as with leading hospitals – East and West Tallinn Central Hospitals, North Estonia Medical Center, Health Insurance Fund, TEHIK, Genome Center, and several IT companies.

Due to the lack of new projects and because of gradually completing existing ones, the number of academic staff decreased in the lab. There are 14 people in academic work. In addition, eMedLab had contracts with several specialists (nearly 20) to carry out our master's program in 12 subjects.

The eMedLab teaching, development and research work is in a very interesting area – digital health/e-Health – which is a hot topic worldwide. This gives a positive background to our center staff.

The budget of the eMedLab was not changed remarkably on 2022, of which about one-third is earmarked for teaching. However, there is expected to be a decrease in resources in 2023.

Working in the field of e-health in parallel with teaching work gives a lot to the content of teaching and allows one to teach the skills needed in real life.

The eMedLab teaching, development and research work is in a very interesting area – digital health/e-Health – which is currently a hot topic worldwide. This gives a positive background to our center staff.

The budget of the eMedLab is between EUR 200-250 thousand, of which about half is earmarked for training and the other half for different projects. Only the teaching staff costs are about 150 thousand euros a year. Working in the field of e-health in parallel with the teaching work gives a lot to the content of teaching and allows to teach the skills needed in real life. To ensure the eMedLab's sustainability, we need to think about the following:

- Optimizing teaching (less of own subjects, more collaboration with other curricula, fewer students in our subject area, more focused topics with master's theses to ensure the best involvement of the eMedLab's staff;

- Closer co-operation with organizations working in the field of e-health in Estonia to find funding specifically for development and research in their field (Ministry of Social Affairs, TEHIK, Health Insurance Fund, UT Estonian Genome Bank, maybe also some e-health companies);
- More precise selection of international project applications in order to avoid wasting time for the eMedLab's staff to write applications with a low probability of funding.

TalTech R&D priority areas

- Health Technologies
- Dependable IT solutions

Field of research

- 3. Medical and health sciences - 3.3 Health sciences
- 3. Medical and health sciences - 3.4 Medical biotechnology

CERCS classification

T115 Medical technology

Participation of the research group members in the activities of international R&D organizations, membership of foreign academies

Two of the Labs employees are World Bank and one Asian Development Bank and German Development Bank KfW consultants in the field of eHealth.

Information on applied research and development activities of the research group

eMedLab has got funding of the following international projects for the next two years:

- HealthSense. In cooperation with Health and Welfare Information System Center and Software Technology and Applications Competence Centre (STACC).
- Nordic eHealth for Patients: Benchmarking and Developing for the Future (NordForsk). The consortium includes 4 universities from Sweden and 1 university from Finland, Norway and USA.