Section b: Curriculum vitae (max. 2 pages)

PERSONAL INFORMATION

Name: Mardal, Kent-Andre
Research identifier; website   (https://orcid.org/0000-0002-4946-1110; https://kent-and.github.io/)
Date of birth: 26.11.1974
Nationality: Norwegian

- **EDUCATION**

2003   PhD. Thesis title: Software and Numerical Methods for the Incompressible Navier-
                    Stokes Equations. Supervisors: Hans Petter Langtangen and Aslak Tveito.
                    Department of Informatics, University of Oslo, Norway.
1999   Cand.Scient, Department of Informatics, University of Oslo, Norway.

- **CURRENT POSITIONS**

2015 – present   Professor, Division of Mechanics, Department of Mathematics, University of Oslo, Norway
2014 – present   Adjunct Chief Research Scientist (equivalent to Professor), Department of Numerical Analysis
                            and Scientific Computing, Simula Research Laboratory, Norway
2019 – present   Consultant, Expert Analytics, Norway

- **PREVIOUS POSITIONS**

2014 – 2015   Associate Professor, Department of Mathematics, University of Oslo, Norway
2007 – 2017   Group leader at Center of Excellence, Center for Biomedical Computing, Norway
2007 – 2014   Senior Research Scientist, Simula Research Laboratory, Norway
2003 – 2014   Associate Professor (20%), Department of Informatics, University of Oslo, Norway
2003 – 2007   Postdoctoral Fellow, Simula Research Laboratory, Norway

- **GRANTS AND AWARDS**

2022-2026   PI: "Computational Hydrology project" (7 MNOK) strategic initiative "Sustainability"
                          at the Faculty of Natural Sciences, UiO
2022   Researcher of the Year Award, Simula Research Laboratory
2020 – 2024   PI: "Alzheimer's Physics" (12 MNOK), FRIPRO, Research Council of Norway (RCN)
2019-– 2023   PI: "SciML – Scientific Machine Learning", (16 MNOK), IKTPLUSS, RCN
2018 – 2021   Workpackage leader of "Novel cascade technology for optimal utilization of animal
                          and marine by products " (2MNOK), collaborative project (BIONÆR), RCN
2017-– 2021   PI: "OPSECTS – Optimal Patient Specific Electro Convulsive Therapy Simulator", (4 MNOK)
                          PhD student joint with industry partner Expert Analytics, RCN
2017-– 2019   co-PI: Developing the course "Computational Mathematical Modeling" (900 KNOK), with
                          Logg (Chalmers) and Matheisen (Copenhagen), Nordforsk
2017-– 2018   co-PI: "Brain, aging and neurodegenerative disease" (80 KNOK), exchange with
                          Neuroscientists in Toulouse, RCN
2015-– 2016   co-PI: "Improved intercranial pressure estimations using cloud-based simulations of the
                          cerebral blood flow" (200 KEUR), within the Fortissimo project, EU-7th FP
2011-– 2015   PI: "Patient-specific mathematical modeling with applications to clinical medicine: Stroke and
                          syringomyelia" (7 MNOK), RCN funded as a result of being shortlisted for ERC funding

- **SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS**

2002 – 2023   13 postdocs (11 as main supervisor; 5 of which are ongoing)/32 PhD students (14 as main
                          supervisor; 4 of which are ongoing)/44 Master Students (26 as main supervisor; 2 of which are
                          ongoing). Institutions for PhD students: University of Oslo (28); University of Siegen (1);
                          Isitutio Italiano di Tecnologia (1), Norwegian University of Science and Technology (2).

- **TEACHING ACTIVITIES** (University of Oslo) (Spring: S, Fall: F)

2015 – 2023   Lecturer – MEK4250 – Computational Mechanics S15, S16, S17, S18, S19, S21, S23

2020 – 2022	Lecturer – MEK4300 – Viscous Flow and Turbulence F22
2017 – 2018	Lecturer – MEK3570 – Computational Solid Mechanics F17, F18
2014 – 2019	Lecturer – MEK3220 – Continuum Mechanics F14, F15, F16, F19
2013 – 2014	Lecturer – INF-MAT5650 – Finite Elements for Partial Differential Equations S13, S14
2012 – 2013	Lecturer – INF-MAT3360 – Partial Differential Equations S12, S13
2004 – 2009	Lecturer – INF5670 – Numerical Methods for Navier-Stokes equations F04, F06, F07, F09
2002 – 2010	Lecturer – INF5600 – Iterative Methods and Multigrid S02, S03, S04, S05, S07, S10
2004 – 2007	Lecturer – INF5660 – Advanced problem solving with high level languages S04, S05, S06, V07

- **ORGANISATION OF SCIENTIFIC MEETINGS**

2022	Organizer, Glymphatic Symposium (50 participants), Oslo, Norway
2021	Organizer, Glymphatic Symposium (50 participants), Oslo, Norway
2019	Organizer, CSF Symposium (50 participants), Oslo, Norway
2019	Organizer, Bio-mechanics workshop (50 participants)
2018	Organizer, Bio-Mechanics workshop on micro-circulation and plasticity in tissue (50 participants), Norway
2017	Organizer, Biomechanics of Living Systems from Cells to Organisms (50 participants), Norway
2013	Organizer, Nordic Seminar of Computational Mechanics (150 participants), Norway
2007-2017	Organised various workshops at the Center of Excellence "Biomedical Computing", Norway

- **INSTITUTIONAL RESPONSIBILITIES**

Invited Referee for Research Councils (12):
2023 ANR, French National Research Agency; 2023 Welcome Trust, UK; 2022 Czech Science Foundation, GACR; 2022 FWF Austrian Science Fund; 2021 U.S. Army Program: Biomathematics; 2021 FONDECYT, National Research and Development Agency, Chile; 2019 Université libre de Bruxelles (ULB); 2012 & 2017 The French National Research Agency (ANR); 2016 Canadian Council for the Arts, Killam Fellowship; 2013 & 2016 Research Foundation Flanders (FWO), Belgium

Habilitation/PhD evaluation committee (15):
2023 PhD thesis: Yun Bin (Oxford University, UK), 2023 PhD thesis: Björn Sigurdsson (University of Copenhagen, Denmark), 2019 PhD thesis: Paolo Zuniga (Universidad del Bio-Bio, Chile), 2019 PhD thesis: Lorenzo Sala (University of Strasbourg, France), 2019 PhD thesis: Mats Brun (University of Bergen, Norway), 2017 Habilitation thesis: Marcela Szopos (University of Strasbourg, France), 2017 PhD thesis: Helena Sviholva University of Prague, Czech Republic), 2016 PhD thesis: Kartik Jain (University of Seigen, Germany), 2016 PhD thesis: Guilia Pizzichelli (Istituto Italiano di Tecnologia, Pisa, Italy), 2015 PhD thesis: Erika Lindstrøm (University of Oslo, Norway), 2010 PhD thesis: Arne Morten Kvarving (NTNU, Trondheim, Norway), 2010 PhD thesis: Sylfest Glimsdal (University of Oslo, Norway)

- **REVIEWING ACTIVITIES**

| 2020 – | Editorial Board; Frontiers in Computational Physics, Frontiers in Bioengineering and Biotechnology |
| 2019 – | Editorial Board; Fluid and Barriers in the CNS |

- **MAIN COLLABORATORS:**

    Medicine: Per Kristian Eide, Department of Neurosurgery, University Hospital of Oslo, Norway; Geir Ringstad, Department of Radiology, University Hospital of Oslo, Norway; Laura Bojarskaite and Rune Enger at Basic Medicine, University of Oslo, Norway, Anders Eklund, Department of Radiation Sciences, University of Umeå, Sweden; *Mathematics:* Miroslav Kuchta and Marie Rognes, Simula Research Laboratory, Oslo, Norway; Paolo Zunino MOX, Politecnico Milan, Italy; Ludmil Zikatanov, Penn State University, US; Ricardo Ruiz-Baier, Monash University, Australia;

Appendix: All on-going grants and submitted grants applications of the PI (Funding ID)
Mandatory information (not counted towards page limits)

On-going grants (Please indicate "No funding" when applicable):

| *Project Title*	*Funding s*	*Amount (Euros)*	*Period*	*Role of the*	*Relation to current ERC proposal*
SciML	RCN	1.6 M	2019-2023	PI	No relation (the project is soon done and was concerned with initial and simplified inverse/ML modelling)
Alzheimer´s physics	RCN	1.2 M	2020-2024	PI	No relation (the project is soon done and was concerned with simplified modelling)

Grant applications (Please indicate "None" when applicable):

Project Title	*Funding sour*	*Amou (Euro*	*Period*	*Role of the PI*	*Relation to current ERC proposal[3]*
Brain Fluids	Jebsen found	2.5 M	2024-2028	Partner	No significant relation (Our role in this project is: Image based quantification and the use of established models - the project focuses on translational aspects rather than model and method development)

Section c: Ten years track-record (max. 2 pages)
Throughout my research career, I have built an inter-disciplinary research group with strong ties to both basic and medical science, rooted in applied mathematics and computational mechanics, and developed an excellent network of collaborators. Over the past 10 years, I have led a research group of 5-10 PhD students and postdocs, developed important new knowledge and tools that are transforming my research and clinical fields, and organized numerous topical meetings to facilitate their sharing and use. I have also taught hundreds of university students a combination of state-of-the-art methods and tools, practical programming experience and habits, and inter-disciplinary perspectives, all in service of enticing the next generation of scientists to tackle critical societal challenges.

	All	Since 2017
Citations	8563	5685
h-index	39	30
i10-index	87	77
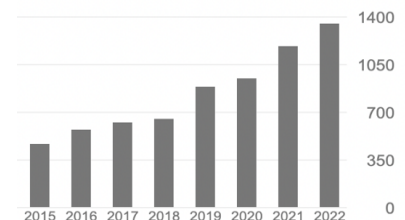
My track record of groundbreaking research over the past 10 years spans several different disciplines, including numerical analysis, scientific computing, biomechanics, and neuroscience. In *numerical analysis and scientific computing,* I am the main developer of the theory of operator preconditioning. I have developed this technique along several different tracks, including fluid flow, poro-elasticity, inverse problems, fractional problems and multi-physics problems. I have published two highly cited works on this topic [2,4] and more than 29 papers in mathematical journals since 2013 including 16 in SIAM journals. I have been actively developing scientific software resulting in several open source packages, of which FEniCS is the most recognized (I was a FEniCS core developer from 2006-2016). FEniCS is widely recognized as a game-changer for finite element methods, and our book on the topic from 2012 has more than 3300 citations. In 2016 I entered the field of *neuroscience* in the context of brain fluids and glymphatics and have published 25 papers on the subject in journals such as Brain, PNAS, and Nature Comm. My image-based analysis, which includes every step from image analysis to mesh generation and computational modeling, has transformed clinical practice at Oslo University Hospital in Norway. Together with clinical collaborators, I have published several papers, including a highly cited article [8], that are transforming the field in terms of the tools available for clinical assessment and quantification, as well as computational modeling.

My research has always been rooted in open science, open source software and dedication to enabling the community with easy-to-use software tools for general application. In total, I have published 127 articles together with 212 co-authors and have a citations/H-index (May 2023) of 3957/31 (Scopus) and 9055/40 (Google Scholar). Thirteen of my publications have more than 100 citations. I have co-authored 3 books and co-edited 2 books, as well as 51 book chapters or refereed proceedings. According to "AD Scientific Index 2023", I am the *Best Scientist in Mechanical Engineering* at the University of Oslo and ranked fourth in all of Norway. I believe my particular contribution is the result of deliberately developing advanced tools for the broader research community, making it easier for other scientists to advance their research.

I have built a productive research group and an exceptional network of national and international collaborations that cover the range of topics, from applied mathematics to neuroscience and clinical medicine, that are needed to meet the challenges inherent in this proposal. My expertise at the intersection of these disciplines makes me uniquely positioned to identify key challenges in this multi-disciplinary setting. Tackling such challenges will be transformative not only for the project at hand, but potentially for mathematics, modeling and medicine more generally.

INVITED LECTURES AT INTERNATIONAL MEETINGS:
Invited keynote/plenary(17) :
More than 150 presentations at conferences and workshops internationally and nationally, *including plenary/keynote* at: The 10th International Conference on Numerical Methods and Applications NM&A'22, Borovets, Bulgaria (2022); The 6th Cerebrospinal Fluid Dynamics Symposium, Gainesville, Florida, USA (2022); The Glymphatic System: From Theoretical Models to Clinical applications, Copenhagen, Denmark (2021); Monash Workshop on Numerical Differential Equations and Applications, Melbourne, Australia (2020); Mathematical Models in Health Sciences, Nantes,

France (2018); I Mathematical and Numerical Modeling of the Cardiovascular System, iNdAM, Rome, Italy (2018); Enumath Voss, Norway (2017); Interpore, Rotterdam, Netherlands (2017); HPCSE, Ostrava, Czech Republic (2017); Cerebrospinal Fluid Dynamics Society Meeting, Atlanta, USA (2017); American Association of Spine Radiology, San Diego, USA (2017); American Society of Neuroradiology, Chicago, USA (2015); International Hydrocephalus Imaging Working Group, Chicago, USA (2015); Cerebrospinal Fluid Dynamics Society Meeting, Amiens, France (2015); Gordon Conference on Flow & Transport in Permeable Media, Portland, USA (2014); Preconditioning Conference, Oxford, UK (2013); Modelling of Physiological Flows, Sardinia, Italy (2013).

SELECTED PAPERS: Below is a selection of the 10 publications from the last 10 years that are relevant to **aClearBrain**. It is important to note that the order of authors varies across disciplines. Authors are listed alphabetically for the mathematical papers [1-5] to signify more equal contributions. For the neuroscience papers [6- 10], I am listed as the second to last author, which signifies that I am the senior author for the technical and modeling parts:

[1] Boon WM, Koch T, Kuchta M, Mardal KA. Robust Monolithic Solvers for the Stokes--Darcy Problem with the Darcy Equation in Primal Form. *SIAM J. on Scientific Computing*. **2022**;44(4):B1148-74.

[2] Lee JJ, Mardal KA, Winther R. Parameter-robust discretization and preconditioning of Biot's consolidation model. *SIAM J. on Scientific Computing*. **2017 (highly cited, cf Web of Science)**

[3] Zapf B, Haubner J, Kuchta M, Ringstad G, Eide PK, Mardal KA. Investigating molecular transport in the human brain from MRI with physics-informed neural networks. Scientific Reports. **2022,** Sep 14;12(1)

[4] Mardal KA, Sogn J, and Takacs S. "Robust Preconditioning and Error Estimates for Optimal Control of the Convection--Diffusion--Reaction Equation with Limited Observation in Isogeometric Analysis." *SIAM J. on Numerical Analysis* 60.1 (**2022**): 195-221.

[5] Mardal KA, Rognes ME, Thompson TB, Valnes LM. Mathematical modeling of the human brain: from magnetic resonance images to finite element simulation. *Springer Nature*; **2022 (Book)**

[6] Bojarskaite L, Bjørnstad DM, Vallet A, Binder KM, Cunen C, Heuser K, Kuchta M, Mardal KA, Enger R. Sleep cycle-dependent vascular dynamics enhance perivascular cerebrospinal fluid flow and solute transport. *Nature Comm*. 14.1 (**2023**) 953.

[7] Eide PK, Vinje V, Pripp AH, Mardal KA, Ringstad G. Sleep deprivation impairs molecular clearance from the human brain. *Brain*. **2021** Mar;144(3):863-**74 (> 100 citations)**

[8] Ringstad G, Valnes LM, Dale AM, Pripp AH, Vatnehol SA, Emblem KE, Mardal KA, Eide PK. Brain-wide glymphatic enhancement and clearance in humans assessed with MRI. *Journal of Clinical Investigations: Insight*. **2018** Jul 26;3(13) **(highly cited, cf Web of Science).**

[9] Holter KE, Kehlet B, Devor A, Sejnowski TJ, Dale AM, Omholt SW, Ottersen OP, Nagelhus EA, Mardal KA, Pettersen KH. Interstitial solute transport in 3D reconstructed neuropil occurs by diffusion rather than bulk flow. *Proc. National Academy of Sciences*. **2017 (> 200 citations)**

[10] Koch T, Vinje V, Mardal KA. "Estimates of the permeability of extra-cellular pathways through the astrocyte endfoot sheath." *Fluids and Barriers of the CNS* 20.1, **2023**

DISSEMINATION TO THE GENERAL PUBLIC:

Year	Topic and venue
2023	VG (most selling newspaper in Norway) reported on our findings on sleep
2021	VG reported on our findings of sleep-related clearance and dementia
2019	National TV (NRK) and radio (P1) + Forskning.no: featured our work on brain clearance
2018	Our research on Alzheimer's appeared in VG, Norway´s top selling newspaper
2017	Our research on Alzheimer's and waste clearance during sleep was featured on national TV

FUNDING TRACK RECORD:

10 projects of 51 MNOK since 10 year from funders incl RCN, EU