

## SAM, D-MATH

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Zurich, August 30, 2020

### Concern: Invitation Letter for Dr. Martin Averseng, Applicant for ETH Zurich Postdoctoral Fellowship

Sehr geehrter Herr Kollege Günther,

with this letter I would like to justify my **strong support** for and interest in the ETH Zurich Postdoctoral Fellowship Application. I had not known Dr. Averseng until last year Prof. Francois Alouges from École Polytechnique, Paris, asked me whether I would be willing to serve as a reviewer for his doctoral thesis on "Méthodes efficaces pour la diffraction acoustique en 2 et 3 dimensions: Préconditionnement sur des domaines singuliers et convolution rapide". After browsing the related research reports, I agreed, because I realized the fundamental nature and substantial potential of that thesis' results, and their importance for my own work.

Dr. Averseng's PhD research has pushed the frontier of numerical and mathematical analysis of boundary integral equations (BIEs) for scattering at open curves and surfaces in several directions:

- He was the first to establish a framework of scales of weighted function spaces, which turns out to be *the* right setting for understanding the BIEs.
- He pioneered the development of a pseudo-differential calculus for *open* curves.
- He exploited the new pseudo-differential calculus for the construction of micro-local preconditioners for Helmholtz BIEs. As demonstrated by numerical tests those allow efficient implementation and perform excellently over wide ranges of frequencies.

This work provides many promising starting points for further research, which can tackle open surfaces in 3D (preliminary work already documented in the thesis) and scattering problems in electromagnetics and linear elasticity.

The focus and direction of Dr. Averseng's research **perfectly complements** my own work of the past few years. I have maintained a strong interest in BIE methods for scattering for many years, first confined to closed surfaces and transmission problems, but shifting to open curves in 2014, when I won an ETHIRA grant for a project about "Scattering at complex screens". Jointly with C. Urzúa-Torres in her PhD work we succeeded in finding operator preconditioners for Galerkin boundary element methods (BEM) for all first-kind BIEs for both acoustic and electromagnetics. However, our work has a blind spot: we could never make explicit the dependence of crucial constants on the frequency. Further progress will require techniques like those invented by Dr. Averseng.

Since 2014 I also collaborated with Dr. X. Claeys from LJLL, UPMC, Paris, to achieve a deeper understanding of BIEs on complicated open surfaces, so-called *complex screens*. We managed to introduce a quotient-space framework and also harness it for novel boundary element discretizations in [X. CLAEYS, L. GIACOMEL,

R. HIPTMAIR, AND C. URZUA-TORRES, *Quotient-space boundary element methods for scattering at complex screens*, Tech. Rep. 2020-11, Seminar for Applied Mathematics, ETH Zürich, under review]. In recent, still unpublished work Dr. Averseng could exploit this idea to construct novel BIEs for screen problems. His ideas also seem to be highly relevant for building frequency-robust preconditioners for complex screens. All this is closely connected to my ongoing SNF-funded project dedicated to “Novel Boundary Element Methods for Electromagnetics”, on which two PhD students are employed currently. Thus from the very beginning Dr. Averseng will be embedded in a group, whose members share almost all of his research interests.

Hardly surprising, I have already offered Dr. Averseng a full postdoctoral position in my group and he will start this week on September 1, 2020. I should add that Dr. Averseng prevailed in a competitive postdoc application procedure implemented on the level of the institute, the Seminar for Applied Mathematics. His research achievements and presentation skills made him the first choice.

The ETH fellowship would be another recognition of his prowess as a researcher in applied mathematics. It would enhance his profile in the community and give him greater independence in his contributions to teaching. His outstanding communication skills would also make him a great messenger for ETH as a leading research institution.

Summing up, Dr. Averseng is a **worthy and outstanding candidate** for an ETH Postdoctoral Fellowship and, in my opinion the case for selecting him is very strong.

Yours sincerely,

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Ralf Hiptmair