

# Activity Report for the Years 2020 and 2021

Christer Oscar Kiselman

Since the academic year 1993/94, the Centre for Image Analysis of Uppsala University (in Swedish *Centrum för bildanalys*, CBA) has published annual reports. From 1997 through 2019 they cover calendar years, which are also fiscal years. On 2021 March 05, the Board of the CBA decided not to prepare any report for 2020; instead it was decided to publish a report in 2022 joint for the two years 2020 and 2021. The Director of the center, Professor Ingela Nyström, informed about this decision on 2021 March 08.

In consequence I have prepared the present report.

## *Contents*

|   |    |
|---|----|
| 1. Fourteen publications .....  | 1  |
| 2. Works accepted for publication .....   | 4  |
| 3. Editorial work .....   | 4  |
| 4. Five talks .....   | 5  |
| 5. Participation in ten conferences .....   | 6  |
| 6. Seminar at the Centre for Image Analysis .....   | 6  |
| 7. Organization of meetings .....   | 6  |
| 8. Ten referee reports .....  | 7  |
| 9. A paper submitted and rejected .....   | 8  |
| 10. A visitor: Rahul Gaurav .....   | 8  |
| 11. Visits .....  | 8  |
| 12. Memberships in academies .....  | 9  |
| 13. Honors .....  | 10 |
| 14. Memberships in learned societies .....  | 10 |
| 15. Six current research projects .....   | 11 |
| 16. Two completed research projects .....   | 17 |
| 17. <i>Bonemine, Goudurix</i> and <i>Puh</i><br>at the Department of Information Technology ... | 18 |
| 18. Consequences of Covid-19 .....  | 19 |
| 19. A fire .....  | 19 |

## 1. Fourteen publications

During the two years covered by this report, I have published one scientific article jointly with my former PhD student Erik Melin, one Letter to the Editor cosigned by several mathematicians, and, as a sole author, six articles plus a translation into Polish of one of these, two essays, and three short notes, bringing the total to fourteen.

### 1.1. Lingvoj kaj scienco (20-1)

This is a chapter in a volume entitled *V Międzynarodowe Sympozjum: Język Esperanto – Rozwijanie osobowości ludzkich na etapie młodości i trzeciego wieku – systemy edukacyjne*, pp. 100–121. Proceedings of the Fifth International Symposium held in May 2019 in Wrocław, 138 pp. Edited by Małgorzata J. Komarnicka.

Published by Ars Libri Introligatornia, Wydawnictwo s.c. Lublin, under the auspices of Uniwersytet Wrocławski and Europejskie Centrum Edukacji Międzykulturowej. ISBN 978-83-954307-1-8.

### 1.2. Języki i nauka (20-2)

This is a translation into Polish of the chapter “Lingvoj kaj scienco” mentioned in Subsection 1.1 above and appearing in the same volume, entitled *V Międzynarodowe Sympozjum: Język Esperanto – Rozwijanie osobowości ludzkich na etapie młodości i trzeciego wieku – systemy edukacyjne*, pp. 33–54. Proceedings of the Fifth International Symposium held in May 2019 in Wrocław, 138 pp. Edited by Małgorzata J. Komarnicka.

Published by Ars Libri Introligatornia, Wydawnictwo s.c. Lublin, under the auspices of Uniwersytet Wrocławski and Europejskie Centrum Edukacji Międzykulturowej. ISBN 978-83-954307-1-8.

### 1.3. André Martineau: Some memories (20-i)

An essay on the life and work of André Martineau (1930–1972), 9 pp.

Published in *Complex Analysis and Operator theory* **14**, No. 7, Article-id 74. Submitted on 2020 June 27. Accepted on 2020 July 29. Published online on 2020 September 14.

### 1.4. Existence of continuous right inverses to linear mappings in finite-dimensional geometry (20-3)

An article joint with Erik Melin, 14 pp.

Published in *Mathematische Semesterberichte*. Submitted on 2020 May 27. Accepted for publication on 2020 July 29. Published online on 2020 October 19.

### 1.5. Cauchy problems for discrete holomorphic functions (20-4)

A chapter in a book devoted to the memory of Carlos Alberto Berenstein (1944–2019), edited by Daniele Struppa & Irene Sabadini (15 pp.).

Published in *Complex Analysis and Operator Theory* **15**, No. 3. Submitted on 2020 April 15. Accepted for publication on 2020 August 12. Published online on 2020 November 02.

### 1.6. Akademio de Esperanto fronte al novaj taskoj (20-ii)

An article based on a presentation during the Conference on Esperanto Studies in Buenos Aires on 2014 July 31, organized by Esther H. Schor and José Antonio Vergara.

Published in *Esperantologio / Esperanto Studies. Nova Serio / New Series 1 (9)*, pp. 41–54, edited by Humphrey Tonkin and Orlando Raola. Accepted for publication

on 2015 December 17. Published on 2020 November 02.  
ISBN 9781595694096, ISSN 1311-3496.

### 1.7. Editor's word of welcome (21-i)

*Matematiko translimen* **8**, 3–5 (2021).

Published in January 2021. ISBN 978-80-88326-14-4.

### 1.8. Elementoj de digita geometrio, matematika morfologio kaj diskreta optimumado (21-1)

*Matematiko translimen* **8**, 11–94 (2021).

Published in January 2021. ISBN 978-80-88326-14-4.

### 1.9. Kiel plej bone faldi triangulon (21-2)

*Matematiko translimen* **8**, 149–155 (2021).

Published in January 2021. ISBN 978-80-88326-14-4.

### 1.10. Editor's introduction (21-ii)

*Aktoj de Internacia Scienca Akademio Comenius*, Volume **2**, 3–6 (2021).

Published on 2021 January 20. ISBN 978-80-88326-15-1.

### 1.11. La jidogramatiko de Zamenhof kaj lia Lingvo universala (21-a)

*Aktoj de Internacia Scienca Akademio Comenius*, Volume **2**, 85–191 (2021).

Published on 2021 January 20. ISBN 978-80-88326-15-1.

### 1.12. La rektoj de Eŭklido (21-3)

*Aktoj de Internacia Scienca Akademio Comenius*, Volume **2**, 192–210 (2021).

Published on 2021 January 20. ISBN 978-80-88326-15-1.

### 1.13. Letter to the Editor (21-iii)

Persson, Ulf; Schubring, Gert; Ullrich, Peter; Kiselman, Christer Oscar; Stubhaug, Arild. Letter to the Editor of the *Notices of the American Mathematical Society* **68**, Number 3, 319–320. Published on 2021 February 23. [A letter to the Editor criticizing actions by the Director of Institut Mittag-Leffler done with support by the Chairman of the Board of this world-famous institution.]

### 1.14. Existence of continuous right inverses to linear mappings in finite-dimensional geometry (21-4)

An article joint with Erik Melin, 14 pp.

Published in *Mathematische Semesterberichte* **68**(1), 55–68. Submitted on 2020 May 27. Accepted for publication on 2020 July 29. Published online on 2020 October 19. Print version published on 2021 March 10.

### 1.15. Urban Cegrell (1943–2021) (21-iv)

Carlehed, Magnus, representing twelve former PhD students; Kiselman, Christer Oscar. Urban Cegrell (1943–2021) [Obituary of my doctor #2]. Published in four newspapers: *Västerbottens-Kuriren* 2021 August 17; *Svenska Dagbladet* 2021 August 24; *Dagens Nyheter* and *Sundsvalls Tidning* 2021 August 25.

## 2. Work accepted for publication

### 2.1. Zamenhof’s Yiddish Grammar and His Universal Language: Two Projects in Ashkenazi Culture

This is a counterpart, comprising 167 pp., of the Esperanto text mentioned under Subsection 1.11. It will be published by KAVA-PECH, Dobřichovice, the Director of which is Petr Chrdle.

### 2.2. Complex convexity

A chapter (134 pp.) intended for the *Handbook of Complex Analysis*, edited by Steven G. Krantz and to be published by Taylor & Francis.

Submitted on 2021 January 08. Two referee reports received on 2021 January 16. Accepted for publication on 2021 March 06. Final version sent 2021 November 19.

### 2.3. Elements of Digital Geometry, Mathematical Morphology, and Discrete Optimization

A book manuscript (xxiv + 461 = 485 pp.), submitted on 2020 November 29. Accepted for publication by World Scientific, Singapore, on 2021 March 11. Almost final version sent 2021 May 20. Final version sent 2021 December 02. Publication is planned for 2022.

### 2.4. Duality of convolution operators: A tool for shape analysis

Manuscript submitted on 2019 April 30 (19 pp.). Two referee reports received on 2020 July 20. Revised version sent on 2020 July 23. Accepted for publication in Springer’s series *Mathematics and Visualization* on 2021 July 14.

## 3. Editorial work

### 3.1. *Matematiko translimen*, No. 8

The eighth issue of the journal of *Internacia Asocio de Esperantaj Matematikistoj*, with five articles by four authors and comprising 180 pp. The authors are Jón Hafsteinn Jónsson, Shigeaki Nagamachi, François Lo Jacomo and me (author of two articles, 21-1 and 21-2, plus a short note, 21-i). lcm

Published in January 2021. ISBN 978-80-88326-14-4.

### 3.2. *Aktoj de Internacia Sciencia Akademio Comenius, Volume 2 (2021)*

The second volume of the *Aktoj* of the *Internacia Sciencia Akademio Comenius*, named for Johan Amos Comenius (1592–1670), with eight chapters by five authors and comprising 210 pp. The authors are Renato Corsetti (author of two chapters), Fabrizio Angelo Pennacchietti (two), Leif Nordenstorm (one), Humphrey Tonkin (one) and me (two chapters, 21-a and 21-3, plus a short note, 21-ii).

Published on 2021 January 20. ISBN 978-80-88326-15-1.

## 4. Five talks

### 4.1. Ufa

On 2021 April 16 I was invited to give a talk at the Общеинститутский семинар (Obščeinstitutskij seminar) in Ufa via Zoom, invited by Юрий Кордюков (Yuri Kordjukov) at the Институт математики с вычислительным центром УФИЦ РАН (Institut matematiki s vyčislitel'nyym centrom UFIC RAN). Title: *Duality of convolution operators*. Time: 14:00–15:00 Ufa time (11:00–12:00 in Sweden).

There were 20 participants, not only in Ufa but also in Moscow, Saint Petersburg, Nizhny Novgorod and Uzbekistan.

### 4.2. Toulouse

I was invited to give a talk at an international conference in Toulouse, 2021 May 31 through June 04, called *AMAZER: Analysis of Monge–Ampère, A Tribute to Ahmed Zeriahi*. My talk, given on May 31, 17:00–17:30, at the location, had the title “Ahmed Zeriahi, a great mathematician and a faithful friend.” The conference was originally planned to take place in June of 2020, then in September of 2020, and could now finally be realized.

### 4.3. Stockholm

On 2021 September 15, I gave a talk at the *Analysis Day in Memory of Mikael Passare* at Stockholm University, being physically present. It had the title *A study of two explanations in the general theory of relativity*.

### 4.4. Fribourg, first talk

Professor Enrico Le Donne at Université de Fribourg invited me to give a mathematical lecture on 2021 October 14. It had the title *Discrete phenomena, which are of growing interest in science, can be difficult but need to be understood*.

### 4.5. Fribourg, second talk

Professor Katharina M. Fromm, Vice-Rector and Dean at Université de Fribourg, invited me to give a lecture on 2021 October 15 at the Faculté des Sciences et de Médecine. It had the title *Living with mathematics and languages*.

This was the eleventh talk in a series of lectures called *Fribourg Chaim Weizmann Lectureships*, named for Chaim Weizmann (1874–1952), Israel’s first president, who

earned a PhD degree in chemistry in 1899 at this university. One of my predecessors in this series is Dan Shechtman, Technion, Haifa.

## 5. Participation in ten conferences

During 2020 and up to September 2021, I have talked in two conferences and participated in eight conferences without giving a talk:

- 5.1. 2020 August 01–08: The 105th World Congress of Esperanto; took place as a Zoom meeting.
- 5.2. 2020 November 10–15: The conference *Limmud* took place as a Zoom meeting.
- 5.3. 2020 November 25–27: *10th International Conference on Numerical Geometry, Grid Generation and Scientific Computing, Celebrating the 130th Anniversary of Boris Delaunay*. A Zoom meeting.
- 5.4. 2020 December 10–11: *Several Complex Variables—The Nordic Covid Sessions*. A Zoom meeting organized by Erlend Fornæss Wold.
- 5.5. 2021 May 31 — June 04: *AMAZER: Analysis of Monge–Ampère: A Tribute to Ahmed Zeriahi* in Toulouse 2021 May 31 through June 04. Invited to give a talk; see Subsection 4.2 above.
- 5.6. 2021 July 17–24: The 106th World Congress of Esperanto; took place as a Zoom meeting.
- 5.7. 2021 July 22: The 43rd Conference on Esperanto Studies; a Zoom meeting.
- 5.8. 2021 September 15: *Analysis Day in Memory of Mikael Passare* at Stockholm University. Three lectures were given via Zoom and one, mine, was presented on location; see Subsection 4.3 above.
- 5.9. 2021 December 09–11: *Several Complex Variables – The Nordic Covid Sessions II*, at University of Oslo; also via Zoom. Organized by Tuyen T. Truong, Håkan S. Kalm and Erlend F. Wold. Nine lectures. I listened via Zoom to some of the talks.
- 5.10. 2021 December 14–15: *International Science Programme 60 Years*. This was a celebration of the sixty years of existence of the International Science Programme (ISP) extended over one and a half day. I participated via *AppInConf*. I was a member of the Reference Group for Mathematics of ISP for sixteen years, 2002–2017.

## 6. Seminar at the Centre for Image Analysis

On 2021 June 14, at 14:15–15:00, I gave a talk via Zoom at the Centre for Image Analysis (CBA), entitled “Writing and publishing: Some experience acquired.” I reported on my experience from writing articles and books during the last twenty years.

## 7. Organization of meetings

I was “Honorary Chair” at the *IAPR International Conference on Discrete Geometry and Mathematical Morphology* (DGMM 2021), taking place during four days: 2021 May 24–27.

The one-day conference *Analysis Day in Memory of Mikael Passare* on 2021 September 15 was organized by Mats Andersson, Christer Oscar Kiselman, and Pavel Kurasov.

## 8. Ten referee reports

### 2020.R1. *SIAM Journal of Imaging Sciences*

Alex Bronstein asks about a revision of the manuscript mentioned in the report for 2019 under Subsection 2019.R8. Received 2020 January 11. Referee report sent 2020 February 02.

### 2020.R2. *Image analysis and Stereology*

Marko Kreft asks about a submitted manuscript. Received 2020 January 19. Referee report sent 2020 February 06.

### 2020.R3. *Dagstuhl Proceedings Volume, Springer*

Michael Breuß asks about a submitted chapter to the proceedings volume after the Dagstuhl Conference in October 2018. Manuscript received 2020 May 04. Referee report sent 2020 May 14.

### 2020.R4. *SIAM Journal on Imaging Sciences*

Alex Bronstein asks about a new revision of the manuscript mentioned under 2020.R1 above. Manuscript received 2020 May 05. Report sent 2020 May 11.

### 2020.R5. *Ufa Mathematical Journal*

Yuri A. Kordyukov asks about a submitted article. Manuscript received on 2020 November 08. Referee report sent on 2020 November 18.

### 2021.R1. *DGMM 2021*

Joakim Lindblad asks about an article submitted to the proceedings volume of the conference *Discrete Geometry and Mathematical Morphology* (DGMM 2021), to be held in Uppsala 2021 May 24–27.

Manuscript received on 2020 December 29. Referee report sent on 2021 January 10.

### 2021.R2. *Ufa Mathematical Journal*

Yuri A. Kordyukov asks about a revised version of the article mentioned in Subsection 2020.R5 above. Manuscript received on 2021 January 10. Referee report sent on 2021 January 14.

### 2021.R3. *World Scientific, Singapore*

SOH Jing Wen asks about a book project submitted to World Scientific. Manuscript received on 2021 March 24. Referee report sent on 2021 April 07.

**2021.R4. *Journal of Mathematical Imaging and Vision***

Filip Malmberg asks about a manuscript submitted to the *Journal of Mathematical Imaging and Vision*. Manuscript received on 2021 July 12. Referee report sent on 2021 July 17.

**2021.R5. Springer Nature**

Katherine Dolhon of Springer Nature asks about a book manuscript. Manuscript received on 2021 July 19. Referee report sent on 2021 August 11.

**9. A paper submitted and rejected****9.1. André Martineau: Quelques souvenirs**

An essay on the life and work of André Martineau (1930–1972) (7 pp.).

Submitted to *la Gazette des Mathématiciens* on 2020 June 23. Rejected on 2020 June 26 by the Editor-in-Chief, Damien Gayet.

**10. A visitor: Rahul Gaurav**

Rahul Gaurav at Institut du Cerveau, Paris Brain Institute (ICM), Pitié-Salpêtrière Hospital, visited Uppsala University during a week, 2020 November 29 through December 06. I was his main host.

The Centre for Image Analysis invited him for a seminar on November 30, chaired by Robin Strand.

The Centre for Interdisciplinary Mathematics, invited Rahul for a lecture on December 01 in the seminar series *Complex Systems* (CoSy), chaired by Benjamin Meco.

At both these occasions, physical participants were few; those on Zoom, many.

**11. Visits****11.1. Pascal Adjamagbo**

I met Pascal Kossivi Adjamagbo for scientific discussions in Paris on 2021 May 29 and June 07. He is Professor at *Université Paris Sorbonne* (formerly *Université Pierre et Marie Curie, Paris 6*). He is interested on the Jacobian conjecture (a famous open problem) and in the history of the development of African science.

**11.2. Rahul Gaurav**

I met Rahul Gaurav for scientific discussions in Paris on 2021 June 06 and 08. He is currently preparing a PhD Thesis. See also Section 10 and Subsection 11.7.

**11.3. Jean Serra**

I met Jean Serra (one of the two creators of mathematical morphology) for scientific discussions in Paris on 2021 May 29 and June 06.



#### 11.4. Henri Skoda

I met Henri Skoda for scientific discussions in Paris on 2021 June 05. He is Professor Emeritus at *Université Paris Sorbonne* (formerly *Université Pierre et Marie Curie, Paris 6*).

#### 11.5. Hughes Talbot

I met Hughes Talbot for scientific discussions in Paris on 2021 June 08. He is Professor of Artificial Intelligence and Computer Vision at CentraleSupélec in Paris, and has worked in Australia during ten years.

#### 11.6. Michel Waldschmidt

I met Michel Waldschmidt for scientific discussions in Paris on 2021 June 07. He is Professor Emeritus at *Université Paris Sorbonne* (formerly *Université Pierre et Marie Curie, Paris 6*). Now working on Lidstone polynomials, among many other things. Cooperating with the International Science Programme, Uppsala.

He has been President of the *Société Mathématique de France* from June 2001 to June 2004, and Vice-President of CIMPA (*Centre International de Mathématiques Pures et Appliquées*) from January 2005 to January 2009, and is still cooperating with this center.

#### 11.7. Rahul Gaurav's thesis defense

On 2021 October 12, at 14:30, Rahul Gaurav defended his Doctoral Thesis entitled *Nigral Neuromelanin and Iron Content Characterizing Parkinson's Disease and REM Sleep Behavior Disorder. A Multimodal MRI Study Using Deep Learning* at Sorbonne Université, *École doctorale 158, Cerveau, Cognition et Comportement (3C)*. The defense took place at ICM, *Institut du Cerveau*, the Paris Brain Institute, Pitié-Salpêtrière Hospital. I was there.

#### 11.8. Visit to *Centre de recherche et de documentation du Jura bernois*

Jerry Krattiger and I visited on 2021 October 19 the research center *Memoires d'ici; Centre de recherche et de documentation du Jura bernois* in Saint-Imier, State of Jura. This center is unique in the world in its status and functioning. Jura is the most recent canton, or state, to have joined the *Confœderatio Helvetica*.

We received a comprehensive presentation of the center by Sylviane Messerli, *Directrice* of the center. She had prepared many documents of special interest for us.

Sylviane defended her doctoral thesis, entitled *Œdipe enténébré. Légendes d'Œdipe au XIIIe siècle*, at Université de Genève in 2001.

## 12. Memberships in academies

|   |                |
|---|----------------|
| Royal Academy of Arts and Sciences, Uppsala | 1983 – present |
| Royal Society of Sciences, Uppsala          | 1984 – present |
| International Academy of Sciences (AIS)     | 1984 – present |
| <i>Internacia Scienca Akademio Comenius</i> | 1986 – present |

|   |                  |
|---|------------------|
| [Esperanto Academy  | 1989–2015-12-15] |
| Royal Swedish Academy of Sciences   | 1990–present     |
| <i>Polska Akademia Umiejętności</i> (Polish Academy of Arts and Sciences)       | 2002–present     |
| Confirmed by the President of the Republic of Poland on                         | 2002 July 12     |
| The diploma handed over by the Ambassador of Poland to Sweden, Marek Prawda, on | 2003 June 10     |

### 13. Honors

|   |                 |
|---|-----------------|
| <i>Docteur Honoris Causa</i> , Université Paul Sabatier, Toulouse.  |                 |
| Approved by the Minister of National Education on   | 2000 July 06    |
| Title awarded in Toulouse on  | 2002 May 17     |
| Gold medal for Zealous and Devoted Public Service, Kingdom of Sweden  | 2001 June 08    |
| <i>Officier de l'Ordre National du Mérite</i> , appointed by the President of the French Republic, Jacques Chirac. Decree dated   | 2002 April 05   |
| The insignia of the order handed over by the Ambassador of France to Sweden, Patrick Imhaus, on   | 2002 October 23 |
| Gustavus Adolphus Gold Medal, awarded by Uppsala University on  | 2006 May 15     |
| Honorary member, AIS-Bulgaria, elected on   | 2013 June 25    |
| Diploma of the Universal Esperanto Association for outstanding activity for the International Language Esperanto; for works and publications in science and interlinguistics. |                 |
| Received in Buenos Aires on   | 2014 August 02  |
| Pirlot Prize of the International Academy of Sciences in the category <i>Courses</i> (one of two prizes for the years 2013–2018).   |                 |
| Decision announced in Lisbon on   | 2018 August 03  |
| <i>Docteur Honoris Causa</i> . Jesper Andersson, Dean at Linnaeus University, calls me on 2021 September 30 to inform me that I will receive an honorary doctorate on         | 2022 January 28 |

### 14. Memberships in learned societies

|   |               |
|---|---------------|
| Swedish Astronomical Society (Life member)                          | 1954–present  |
| Swedish Mathematical Society (Life member)                          | 1960s–present |
| American Mathematical Society (Life member)                         | 1966–present  |
| Société Mathématique de France                                      | 1960s–present |
| European Mathematical Society                                       | 1990s–present |
| Uppsala Humanistiska Förbund (The Uppsala Union for the Humanities) | 1990s–present |
| Scandinavian Society for Iranian Studies (Associate member)         | 2010–present  |

## 15. Six current research projects

### 15.1. Complex convexity

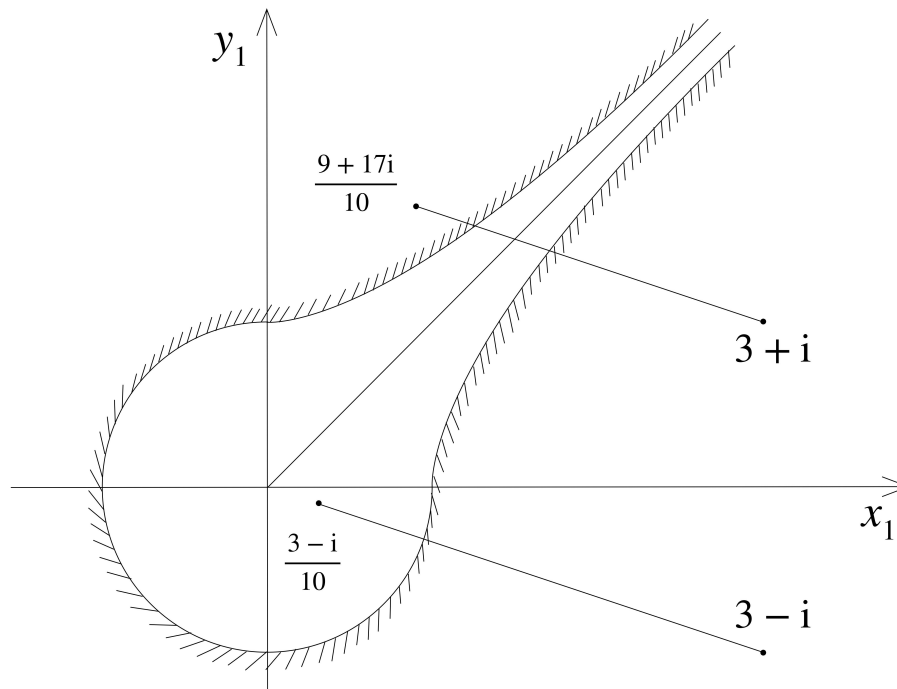


Figure 1. (Project 15.1.) The base in the complex plane of a locally linearly convex set in  $\mathbf{C}^2$  which is not linearly convex.

From publication 16-1; courtesy Hania Uscka-Wehlou.

*Project manager:* Christer Oscar Kiselman.

*Project description:* Two complex variables correspond to four real variables, so in complex geometry, we need to see in four dimensions or more. Can you see in four dimensions without building a *Theatrum Visuale* showing all four dimensions? Yes, it is indeed possible to train one's inner eyes to see in four dimensions. A nontrivial but most rewarding sport. We can actually arrive at true stereoscopic vision ...

A bounded open set with boundary of class  $C^1$  which is locally weakly linearly convex is weakly linearly convex, but, as shown by Yuriĭ Zelinskiĭ, this need not be true for unbounded domains. We construct explicit examples, Hartogs domains, showing this. Their boundary can have regularity  $C^{1,1}$  or  $C^\infty$ .

Obstructions to constructing smoothly bounded domains with certain homogeneity properties are presented.

A current activity is a study of one-sided regularity of subsets of  $\mathbf{R}^n$  or  $\mathbf{C}^n$ . Preliminary results on this kind of regularity were presented at a conference at Stockholm University on 2015 September 16; cf. Subsection 1.7 in the report for 2019.

*Advisors:* Jan Boman, Ragnar Sigurdsson, and Mats Andersson.

*Financed by:*

1. Université de Nice 1967-10-01 — 1968-09-30;
2. Uppsala University 1968-10-01 — 2006-04-30;
3. Kingdom of Sweden 2006-05-01 — present.

*Publications:* There are several publications in this project; the latest (19-1) appeared online in July 2019; the print version was published in October 2019.

A chapter intended for a book entitled *Handbook of Complex Variables* and edited by Steve Krantz, was submitted on 2021 January 08 and accepted on 2021 March 06.

*Period:* 1967-10-01 — present.

## 15.2. Elements of Digital Geometry, Mathematical Morphology, and Discrete Optimization

*Project manager:* Christer Oscar Kiselman.

*Project description:* A book on fundamentals of three related fields of knowledge: digital geometry, mathematical morphology, and discrete optimization.

*Partners:* Erik Melin, Hania Uscka-Wehlou, Shiva Samieinia, Adama Arouna Koné.

*Advisors:* Jean Serra, Jesús Angulo.

*Period:* 2002 — .

*Financed by:* Christer Oscar Kiselman:

1. Uppsala University 2002 — 2006-04-30;
2. Kingdom of Sweden 2006-05-01 — present.

Hania Uscka-Wehlou:

1. Man In The Middle AB (MITM);
2. Uppsala University 2017 August 15 — 2019 August 13;
3. Mälardalen University 2019 August 14 — present.

Shiva Samieinia:

1. The Royal Institute of Technology;
2. Stockholm University;
3. The Ruth and Nils-Erik Stenbäck Foundation.

Adama Arouna Koné:

1. International Science Programme (ISP) 2011–2016;
2. Université des Sciences, des Techniques et des Technologies de Bamako (USTTB), Bamako I, 2011 — 2018 January 07;
3. École Normale d'Enseignement Technique et Professionnel (ENETP), 2018 January 08 — present.

*Publications:* Lecture notes from 2002 (78 pages) and 2004 (95 pages) are available at my web site.

Lecture notes with the title *Digita geometrio, matematika morfologio kaj diskreta optimumado* (69 pp.) from a course held in Warsaw in September 2017 (18-2). Published in 2018 at the web site of the International Academy of Sciences (AIS).

These lecture notes, somewhat revised, were published in January 2021 (21-1); see Subsection 1.8.

A book manuscript, comprising xii + 458 pages, has now been accepted to be published by World Scientific, Singapore; see Subsection 2.3 above.

### 15.3. Convexity of marginal functions in the discrete case



Figure 2. (Project 15.3.) Shiva Samieinia.

*Project manager:* Christer Oscar Kiselman.

*Project description:* We define, using difference operators, classes of functions defined on the set of points with integer coordinates which are preserved under the formation of marginal functions.

The duality between classes of functions with certain convexity properties and families of second-order difference operators plays an important role and is explained using notions from mathematical morphology.

Several generalizations are now being studied.

*Period:* 2010-01-11 — present.

*Partner:* Shiva Samieinia.

*Financed by:* Christer Oscar Kiselman: Kingdom of Sweden.

Shiva Samieinia:

1. The Royal Institute of Technology;
2. Stockholm University;
3. The Ruth and Nils-Erik Stenbäck Foundation.

*Publications:* An article (10-4), joint with Shiva, was published as a part of her PhD thesis. A joint paper (17-5, mentioned in the report for 2017) was published in September 2017. Most of the results are covered by the book manuscript mentioned in Subsection 2.3 above. However, some generalizations remain to be studied. The paper on duality, mentioned in Subsection 2.4 above, is also relevant here.

### 15.4. Digital hyperplanes

*Project manager:* Christer Oscar Kiselman.

*Project description:* Digital planes in all dimensions are studied. The general goal is to generalize to any dimension the results of Kiselman's 2011 paper in *Mathematika* (11-1).



Figure 3. (Project 15.4.) Adama Arouna Koné.

An important part of the study was finished with Adama Arouna Koné's thesis, presented on 2016 January 14. There are, however, several possible generalizations which are now being investigated.

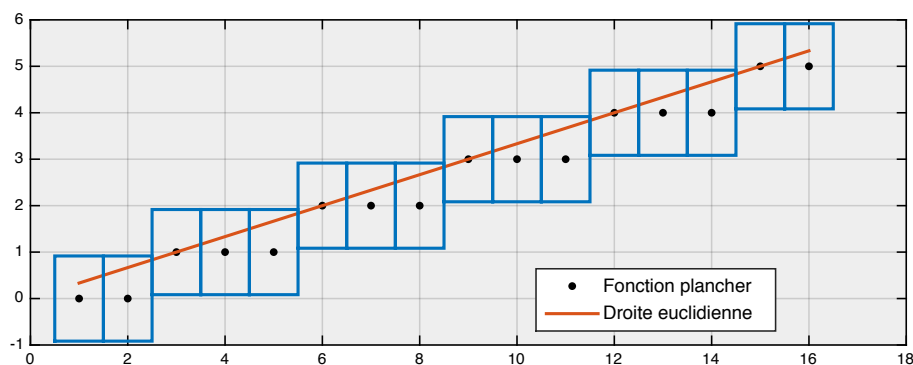


Figure 4. (Project 15.4.) Covering the Euclidean straight line of equation  $y = \frac{1}{3}x$  by a dilation obtained using the floor function and with structuring set equal to the rectangle  $[-\frac{1}{2}, \frac{1}{2}] \times [-\frac{5}{6}, \frac{5}{6}]$ . Courtesy Adama Arouna Koné.

*Period:* 2010-01-11 — present.

*Partner:* Adama Arouna Koné.

*Financed by:* Christer Oscar Kiselman: Kingdom of Sweden.

Adama Arouna Koné:

1. International Science Programme (ISP) 2011–2016;
2. Université des Sciences, des Techniques et des Technologies de Bamako (USTTB), Bamako I, 2011 — 2018 January 07;
3. École Normale d'Enseignement Technique et Professionnel (ENETP), 2018 January 08 — present.

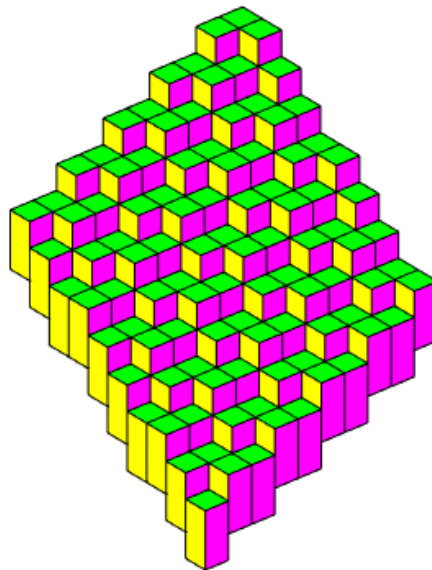


Figure 5. (Project 15.4.) Covering a Euclidean plane by a dilation, using the floor function and with structuring set equal to the box  $[-\frac{1}{2}, \frac{1}{2}] \times [-\frac{1}{2}, \frac{1}{2}] \times [-\frac{9}{8}, \frac{9}{8}]$ .  
Courtesy Adama Arouna Koné.

#### Publications:

Koné, Adama Arouna. 2016. *Géométrie digitale utilisée pour la discrétisation et le recouvrement optimal des objets euclidiens*. PhD Thesis, 114 pages. Bamako: Université des Sciences, des Techniques et des Technologies de Bamako I (USTTB).

Koné, Adama Arouna. 2017. Covering a Euclidean line or hyperplane by dilations of its discretization. *Vietnam J. Math.* **45**, no. 3, 351–368.

The results in this project are covered by the book manuscript mentioned in Subsection 2.3. The project will therefore be completed when this book will appear.

### 15.5. Discrete convolution equations

*Project manager:* Christer Oscar Kiselman.

*Project description:* We study solvability of convolution equations for functions with discrete support in  $\mathbf{R}^n$ , a special case being functions with support in the integer points. The more general case is of interest for several grids in Euclidean space, like the body-centered and face-centered tessellations of three-space, as well as for the non-periodic grids that appear in the study of quasicrystals. The theorem of existence of fundamental solutions by de Boor, Höllig & Riemenschneider is generalized to general discrete supports, using only elementary methods. We also study the asymptotic growth of sequences and arrays using the Fenchel transformation. Estimates using the Fourier transformation are studied.

Now duality of convolution operators is being investigated.

*Advisors:* Jan Boman, Ragnar Sigurdsson.

*Period:* 2012-01-11 — present.

*Financed by:* Kingdom of Sweden.

*Publications:* A paper was published on 2015 May 07 in *Mathematika* (15-2). A second paper appeared in 2017 (17-2); see the report for 2017.

A study of quasicrystals is part of this project. So is the paper on duality mentioned in Subsection 2.4. A majority of the results in this project are covered in the book manuscript mentioned in Subsection 2.3.

### 15.6. Zamenhof's Yiddish grammar



Figure 6. (Project 15.6.) Л. Заменгофъ, L. Zamenhof (1859–1917) around 1879.

*Project manager:* Christer Oscar Kiselman.

*Project description:* Zamenhof wrote a Yiddish grammar (in Russian) around 1880. It was published in full only in 1982. A study of this grammar has been undertaken. In particular, a comparison with his language project *Universal Language* from about the same time is of interest. (*Lingvo universala* was a predecessor of Esperanto, published in 1887.)

*Presentations:*

- 2016 July 29 at a conference in Nitra: “La jidogramatiko de Zamenhof kaj lia Lingvo universala.”
- 2017 November 19 at the *Limmud* conference in Stockholm: “Zamenhofs jiddisch-grammatika och hans språk Lingvo universala.”
- 2017 December 13 at the conference *The Heritage and Legacy of Ludwik Lejzer Zamenhof Between Judaism and Esperanto* at *Muzeum Historii Żydów Polskich POLIN* (The Museum of the History of the Polish Jews, Polin), in Warsaw, 2017 December 13–15. Title: “Zamenhof’s Yiddish grammar and his Universal Language.”
- 2018 February 28 at Uppsala University, Forum for Jewish Studies: “Zamenhof’s Yiddish grammar and his five constructed languages.” Invited by Lars M. Andersson.
- 2019 May 29 at *Zespół Szkół Ogólnokształcących w Złotoryji*, a public school in Złotoryja, “La kvin artefaritaj lingvoj de Zamenhof” (Zamenhof’s five constructed languages). Invited by Małgorzata Komarnicka and Aleksander Pecyna.
- 2019 May 31. I was invited by the organizers of the Annual National Congress of Esperanto, held in Stockholm May 31 through June 02, to give a talk on May 31. My title was “La jidogramatiko de Zamenhof kaj lia Lingvo universala” (Zamenhof’s Yiddish grammar and his Universal Language).



*Publications:* An article was published in November 2016 (16-b), and a short paper appeared in 2019 (19-b).

An article in Esperanto (107 pp.) was published on 2021 January 20; see Subsection 1.11.

A book in English (167 pp.) will be published by KAVA-PECH in 2022; see Subsection 2.1.

*Period:* 2015-08-01 — present. The project will be finished when the last-mentioned book is published. It is a continuation of a similar project, where I studied the influence of Yiddish on Esperanto. This last-mentioned project started in 1982 and gave rise to a publication in 1992; see item 92-a in my web site.

*Financed by:* Kingdom of Sweden.

## 16. Two completed research projects

For some research projects finished earlier, see the reports for 2015 through 2019.

### 16.1. Mathematical concepts and their linguistic expressions in a multicultural setting



Figure 7. Hania Uscka-Wehlou.

*Project manager:* Hania Uscka-Wehlou (Figure 7).

*Partners:* Christer Oscar Kiselman, Adama Arouna Koné (Figure 5).

*Advisors:* Lars Mouwitz, Fanja Rakontondrajao, Amites Rasho, Shiva Samieinia (Figure 2), Xiaoqin Wang.

*Project description:* To study the relation between mathematical concepts and their expression in several languages. Special attention is devoted to the use of non-native languages.

*Period:* 2016-04-01 — 2020-02-29.

*Financed by:*

Hania Uscka-Wehlou:

1. Man In The Middle AB (MITM);
2. Uppsala University 2017-08-15 — 2019-08-13;
3. Mälardalen University 2019-08-14 — 2020-02-29.

Christer Oscar Kiselman: Kingdom of Sweden.

Adama Arouna Koné:

1. Université des Sciences, des Techniques et des Technologies de Bamako (USTTB), Bamako I, 2016 — 2018-01-07;
2. École Normale d'Enseignement Technique et Professionnel (ENETP), 2018-01-08 — 2020-02-29.

*Publications:* Three publications: Hania has published two articles joint with me in 2017 and one as a sole author in 2018. See the reports for 2018, Section 10.8, and 2019, Section 12.8.

*Presentations:* Hania has made five presentations in connection with this project during the years 2016–2018; see the report for 2018, Section 12.8.

## 16.2. Existence of continuous right inverses to linear mappings in elementary geometry

*Project manager:* Christer Oscar Kiselman.

*Project description:* A linear mapping of a compact convex subset of a finite-dimensional vector space always possesses a right inverse, but may lack a continuous right inverse even if the set is smoothly bounded. Examples showing this are given as well as conditions guaranteeing the existence of a continuous right inverse, also for other sets.

*Period:* 2005-09-08 — 2021-03-10.

*Partner:* Erik Melin.

*Advisor:* Hiroshi Yamaguchi.

*Financed by:* Christer Oscar Kiselman:

1. Uppsala University 2005 — 2006-04-30;
2. Kingdom of Sweden 2006-05-01 — 2020-10-19.

Erik Melin: Uppsala University 2005–2008.

*Publication:* The project was finished with the publication (21-4) mentioned in Subsection 1.14 above.

## 17. *Bonemine*, *Goudurix* and *Puh* at the Department of Information Technology

During the calendar year of 2020, I was without access to my documents in the computer system at the Department of Information Technology during twenty-two days.

Three of these days occurred June 24–26; the problem being attributed to the computer *Bonemine*.

Eighteen of the days without access were during October 05–22. In spite of this, emails could be reached from home. The problem was now attributed to the server *Goudurix*, which, according to an internal message of October 14, cannot be repaired, since it is a unique server without spare parts and with no spare parts available on the market.

The importance of a disturbance is indicated along a scale called *Severity*. The problem in October was first classified as *P2 Normal*. It was then raised to *P3 Major* on October 12; then to *P4 Critical* on October 14, and finally to the highest level, *P5 Blocker*. However, these three changes were made not by the IT-specialists but by researchers at the department.

On October 23 I got access to my documents.

Again, on December 06 I did not have access to the computer system. This time, the problem was due the computer *Puh*, to which *Bonemine* was connected. The following day, *Bonemine* was made independent of *Puh*.

Nobody has explained to me why it took so long to bring the computer system to order in October 2020.

## 18. Consequences of Covid-19

Due to the pandemia I had to refrain from, or postpone, several trips, among them to Paris, Toulouse, Montréal and Bern.

In the year 2020 I did not travel at all.

In 2021, I visited Paris and Toulouse in May–June, Portugal in September, Paris and Switzerland in October, and New York City in November.

The second and fourth of these were private; the first and third were done for professional reasons, reflected to some extent in Subsections 4.2, 4.4 and 4.5 above.

Participation in congresses and conferences have also been affected, notably the following.

- *Analysis Day in Memory of Mikael Passare*. A conference to the memory of Mikael Passare (1959–2011) is held at Stockholm University each year in September, exceptionally in October. It is organized by Mats Andersson, Christer Kiselman and Pavel Kurasov (main organizer). The 2020 conference had to be cancelled—but in 2021 we were back.
- A conference in honor of Ahmed Zeriahi was first planned to be held at Université Paul Sabatier in Toulouse in June 2020, then postponed to September 2020, and could finally take place during five days, 2021 May 31 — June 04.
- The *IAPR International Conference on Discrete Geometry and Mathematical Morphology* (DGMM 2021), originally planned to be held at Uppsala University in December 2020, was postponed to 2021 May 24–27.

## 19. A fire

On 2020 October 29, a refrigerator a few meters from the office I use caught fire, destroying everything in that room but nothing in the six adjacent rooms. However, things in the adjacent rooms suffered from bad smell caused by the smoke, and were to be treated with ozone ( $O_3$ ) in order to be freed from the smell.

Two chairs, a lamp, and other objects in the office I use disappeared during the ensuing reparation.

It was announced that the renovation of the seven rooms affected by the fire would take three weeks.

I was offered another office during the time of the renovation and could therefore work uninterruptedly.

After a final inspection on 2021 April 12, we were allowed to move back to the original premises, now perfectly clean and in good shape. I could start to work in my old office on April 28, almost six months after the fire.

Since September 2014, the author is a guest professor at Uppsala University, more precisely at the Department of Information Technology, Division of Visual Information and Interaction (VI2).

*Paper address:* Uppsala University, Department of Information Technology,  
Box 337, SE-751 05 Uppsala, Sweden

*Amber addresses:* [kiselman@it.uu.se](mailto:kiselman@it.uu.se), [christer@kiselman.eu](mailto:christer@kiselman.eu)

*URL:* [www.cb.uu.se/~kiselman](http://www.cb.uu.se/~kiselman)

(The address may be changed later to [www.it.uu.se/~kiselman](http://www.it.uu.se/~kiselman).)

ORCID, *Open Researcher and Contributor ID:* 0000-0002-0262-8913