

Newsletter

BELGIAN MATHEMATICAL
SOCIETY

126, January 15, 2020

Comité National de Mathématique CNM

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NCW Nationaal Comité voor Wiskunde

Newsletter of the Belgian Mathematical Society and the National Committee for Mathematics

Belgian Mathematical Society ASBL/VZW
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The next edition of this newsletter will appear on March 14th, so from now till March 9th all content can be sent to wendy.goemans@kuleuven.be.

Any information that you qualify as interesting to be spread among the Belgian Maths community is very much welcomed! Examples of such information are: PhD defenses, seminars, conferences, workshops, meetings, interaction with other sciences or business companies, popular lectures, school initiatives, math exhibitions, job opportunities, ...

The President's Foreword

Dear members of the BMS,

On behalf of the BMS board, I wish all our members a happy 2020. May it be a wonderful and successful year for all of you. Most of all, I wish you many opportunities to take part in exciting projects, and enough time to be satisfied with your investment in them!

For the new year, I offer you some quotes, in the hope that you find them at least entertaining. Don't hesitate to share your own, for the next edition of this bulletin.

I'm looking forward to seeing you all at some point during the year, perhaps during our General Assembly, which shall take place on March 25 and which we intend to make into a special event with two great speakers! More information shall follow soon.

I wish you all a very happy new year,

Yvik Swan,
BMS President

Quotes :

"How far can you go with Cauchy-Schwarz inequality and integration by parts?" – Dominique Bakry, Ivan Gentil and Michel Ledoux

"Groups, as men, will be known by their actions" – Guillermo Moreno.

"If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is" – John von Neumann.

"We often hear that mathematics consists mainly of 'proving theorems'. Is a writer's job mainly that of 'writing sentences'?" – Gian-Carlo Rota

"I find that I am bored with anything I understand." – Karen Uhlenbeck

1 News from the BMS & NCM

1.1 Membership dues for 2020

The basic BMS membership fee is 20€ per year. See Section 1.1.1 for reciprocity membership.

You can either pay via bank transfer (BIC: GEBABEBB / IBAN: BE70 0011 7447 8525) or via PayPal (see <http://bms.ulb.ac.be/membership/paypal.php>).

Our address is:

Belgian Mathematical Society
Campus de la Plaine, C.P. 218/01
Boulevard du Triomphe
B-1050 Brussels, BELGIUM

1.1.1 Reciprocity and combined membership

The BMS has reciprocity agreements with the AMS, EMS, DMV, LMS, RSME, SMF, SBPMef, VVWL and KWG. In case you are already member of one of these societies, your membership fee for the BMS is reduced to 18€. Details can be found on [this webpage](#).

We summarize the most common combined memberships:

BMS	20,00€
BMS with reciprocity	18,00€
BMS + EMS	45,00€
BMS + EMS with reciprocity	43,00€

Note that the EMS (European Mathematical Society) membership fee of 25,00€ is allowed only to persons belonging to an EMS corporate member society, such as the BMS. The individual EMS membership fee is 50,00€ otherwise.

Note that it is now preferred that you pay your EMS membership fee directly to the EMS. See http://www.euro-math-soc.eu/ems_payment_new/ems_payment_new.html for details.

For your convenience however, it is still possible to pay for a combined EMS+BMS membership (i.e. 45,00€) by bank transfer (BIC: GEBABEBB / IBAN: BE70 0011 7447 8525) or PayPal. We will then forward your EMS membership fee to the European Mathematical Society.

1.1.2 Checking your membership status

To check whether we have received your dues, go to our [online database](#).

Try typing your family name in the search box. If you agreed to have your institution and e-mail in our public database at the time you became a member, you will see your institution and e-mail address. You will also see the year in which you last paid your dues.

If you forgot to pay for more than one year, you will get no response from our database as you are not a member anymore! In this case we suggest you to re-apply for membership by filling out the online form at <http://bms.ulb.ac.be/membership/appliform.php> and transfer your membership fee asap.

1.2 Save the date: March 25 – General Assembly

The General Assembly of the BMS takes place on March 25. More information follows soon.

1.3 Bulletin of the Belgian Mathematical Society - Simon Stevin

In November 2019, Volume 26, Number 4, of the Bulletin of the Belgian Mathematical Society - Simon Stevin appeared with the following table of contents:

- **L. Bernal-González, H. J. Cabana Méndez, G. A. Muñoz-Fernández, J. B. Seoane-Sepúlveda**
Nielsen-Reidemeister indices for multivalued maps. 481–492.

- **M. Gabeleh, C. Vetro** A best proximity point approach to existence of solutions for a system of ordinary differential equations. 493–503.
- **A. Rainer** Quasianalytic ultradifferentiability cannot be tested in lower dimensions. 505–517.
- **F. Cagliari, M. M. Clementino** Topological groups have representable actions. 519–526.
- **Y.-K. Song, W.-F. Xuan** A note on monotonically star σ -compact spaces. 527–534.
- **Z. Hu, Z. Yao, X. Zhang** Hypersurfaces of the homogeneous nearly Kähler S^6 and $S^3 \times S^3$ with anticommutative structure tensors. 535–549.
- **R. M. Ali, S. K. Lee, S. R. Mondal** An averaging formula for the coincidence Reidemeister trace. 551–570.
- **R. P. Pant, N. Y. Özgür, N. Taş** Discontinuity at fixed points with applications. 571–589.
- **F. Durand, V. Goyheneche** Decidability, Arithmetic Subsequences and Eigenvalues of Morphic Subshifts. 591–618.
- **Y. Kurtulmaz, S. Halicioglu, A. Harmanci, H. Chen** Rings in which elements are a sum of a central and a unit element. 619–631.
- **K. Płotka** On lineability of additive surjective functions. 633–639.

For the table of contents of previous issues, see <https://projecteuclid.org/all/euclid.bbms>. Remember, as a member of the BMS you can ask for electronic access to all electronically available issues of the bulletin, if you don't have a login yet, contact pcara@vub.ac.be.

2 Meetings, Conferences, Lectures, ...

2.1 February 2019

5th edition of the Regional Days on Model Theory and Applications (RDMTA)

February 1, 2020

UMONS

This one-day conference is the fifth edition of a seminar which is held in respectively the universities of Dusseldorf, Muenster, Mons and Leuven. It is organized by Immanuel Halupczok (Dusseldorf), Martin Hils and Katrin Tent (Muenster), Raf Cluckers (Leuven), Christian Michaux and Françoise Point (Mons). It began in Mons in January 2017. It gathers model-theorists and algebraists of these universities and encourages the participation of young researchers and master students together with confirmed researchers. The present edition will be held in the mathematical department of the university of Mons, on February 1st, 2020 (De Vinci building, 15 Maistriau avenue, 7000 Mons).

speakers:

- **Sylvy Anscombe** (UCLanscashire, Angleterre): *A new-ish view of complete valued fields of mixed characteristic.*
- **David Bradley-Williams** (Dusseldorf, Allemagne) TBA
- **Daniel Palacin** (Freiburg, Allemagne) *Probabilistically nilpotent groups in model theory.*
- **Nick Ramsey** (ENS-Paris, France) *Classification Theory and the Construction of Pseudo Algebraically Closed Fields (PAC).*

Useful information and registration: <http://www.mathconf.org/rdmta2020>

Flatland Arithmetic: Winter Day – 31st meeting APP**February 10, 2020****Kortrijk****Program:**

- 11:00-12:00 **Alex Bartel** (Glasgow): Class groups of “random” number fields
- 12:00-14:00 Lunch
- 14:00-15:00 **Simon R. Blackburn** (London): Cryptography using group theory
- 15:00-16:00 **Lieven Le Bruyn** (Antwerp): Counting in times of fake fields
- 16:00-16:30 Coffee break
- 16:30-17:30 **Anna Cadoret** (Paris): A Tannakian Chebotarev density theorem
- 19:00 Dinner

Useful information and registration: <http://www.mathconf.org/app-gvl-winter2020>

Ecole doctorale: Services d’Analyse Mathématique et de Probabilités et Statistique**February 20, 2020****Mons**

See the announcement at the end of this newsletter.

GAME2020: Geometric Algebra Mini Event 2020**February 26-28, 2020****Kortrijk**

What makes a new idea in mathematics an accepted one? When Hermann Minkowski introduced his famous metric in 1907, the idea was, backed by the success of Einstein’s relativity theory, almost instantly accepted in the mathematical community.

Yet Hamilton’s 1843 quaternions took decades, despite their now well-understood superiority for treating rotations. Even worse off was W.K. Clifford, whose work combining Grassmann’s exterior algebra with arbitrary metrics, was all but forgotten soon after his early death.

Yet, starting with the work of Hestenes in 1966, Clifford’s Geometric Algebra has gradually started to reveal its potential in an exceptionally wide range of applications. It offers a modern and coordinate-free approach that unifies and clarifies many concepts from vector spaces, differential geometry, exterior algebras, linear algebra, quaternions, spinors, and more. Its geometric nature makes it ideally suited for applications in physics, robotics, computer vision, graphics and everywhere an algebraic treatment of geometry is needed.

In a true “show, don’t tell” mindset, the GAME2020 event has the top researchers and authors presenting the current state of the art of the field. Join us at the end of February, when the campus “The Level” in Kortrijk is transformed for three days into a true temple of Geometry. Find out what the impact of Geometric Algebra could be in your field, or join one of our workshops with researchers from Cambridge, University of Amsterdam, Paris, Darmstadt, and Tokyo.

On Wednesday 26/2, Steven De Keninck elaborates on his SIGGRAPH course and tackles the dual quaternions and the Geometric Algebra that naturally includes this most compact representation of the Euclidean isometries. In the afternoon, Dr. Dorst, author of the reference work “GA4CS”, talks about the relationship with Linear Algebra, and how the lessons learned from Clifford can provide elegant solutions to problems that are intractable otherwise.

On Thursday, Hugo Hadfield and Eric Wieser from Cambridge university demonstrate the power of the Conformal Geometric Algebra for problems in robotics and kinematics. In the afternoon, Cambridge’s Professor of astrophysics and cosmology, Anthony Lasenby, presents his view on GA as a new language for physics. Professor Lasenby is one of the authors of “GA 4 Physicists”, and widely considered one of the pioneers of the field.

On Friday, Dr. Vincent Nozick (UPEM Paris) and Dr. Stephane Breuils (NII-JFLI Tokyo) discuss the impact a natural representation of geometric elements and transformations has on deep learning applications. In the afternoon, Dr. Charles Gunn closes the conference with an extension to his SIGGRAPH course, detailing the treatment of kinematics in curved spaces.

All of the talks in Kortrijk have a follow-up workshop providing the opportunity for detailed questions and discussion. Whether you are working in academia, engineering, computer science, artificial intelligence or even game development, this event is sure to cater to your needs. Don’t miss out on this exceptional opportunity and come join us in Kortrijk this February! For more information on GAME2020, the talks and the workshops, visit <https://bivector.net/game2020.html>

See also the announcement at the end of this newsletter.

2.2 March 2020

Internationale dag van de wiskunde op 14 maart 2020

March 14, 2020

Brussel

De algemene vergadering van de UNESCO heeft 14 maart officieel uitgeroepen als dé internationale dag van de wiskunde. Wereldwijd zullen op deze symbolische dag heel wat evenementen worden georganiseerd om het maatschappelijk belang van de wiskunde te benadrukken.

De Vlaamse vereniging van wiskundeleraars (VWWL) nodigt u alvast uit op 14 maart 2020 in het Planetaarium te Brussel voor de π - en Pi(en)-dag. Er werd een gevarieerd programma uitgewerkt waarbij het getal π uiteraard centraal staat.

Programma:

- 10 uur: Onthaal met koffie of thee

- 10.30 uur: Welkomstwoord door de directeur van het planetarium
- 10.45 uur: “Armand Pien en π ” door prof. dr. Paul Levrie en prof. dr. Rudy Penne (UAntwerpen)
- 12 uur: “De wereld van π in 45 vragen”, Kahoot-quiz door Ivan De Winne
- 12.45 uur: Middagpauze met broodjeslunch
- 13.45 uur: “Klimaatmodellen en wiskunde” door dr. Ir. Steven Caluwaerts (UGent)
- 15 uur: “Armand Pien, van wiskundige tot mijn held” door VTM-weerman ir. David Dehenauw
- 16 uur: Netwerkmoment met receptie
- 16.45 uur: VVWL-jaarvergadering met voorstelling van de VVWL-vzw
- 17.30: Fulldome filmvoorstelling in de koepel van het Planetarium
- 18 uur: Einde

Deelnameprijs: VVWL-leden €10

Niet-leden betalen €45 (jaarabonnement op het tijdschrift W&O inbegrepen)

Inschrijven via de website <https://vwwl.be/>

2.3 Seminars and colloquia

Methusalem colloquium talks

KU Leuven

Scheduled talks are:

- 27.02., 16:15-17:15, Room 200L 00.06: **Mateusz Wasilewski** (KU Leuven). (This talk will at the same time be the introduction to this semester’s mini course.)
- 26.03., 16:15-17:15, Room 200B 00.18: **Mike Whittaker** (University of Glasgow)
- 24.04., 16:15-17:15, Room 200L 00.07: **Mircea Mustata** (University of Michigan)

For all information, see <https://wis.kuleuven.be/methusalem-pure-math/activities/>.

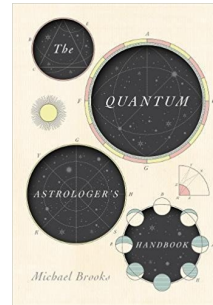
3 History, maths and art, fiction, jokes, quotations ...

3.1 Adhemar’s corner

We start the new year with two reviews of Adhemar on two books by Michael Brooks, the first recent, the second a bit older: **The Quantum Astrologer’s Handbook** is a novel about Cardano while **13 Things That Don’t Make Sense** is a science book of general interest.

The Quantum Astrologer's Handbook by *Michael Brooks*. Scribe, 2017 (248 p.) isbn 978-1-911617-35-8

In a former life Michael Brooks obtained a PhD in theoretical physics, but he switched career and became a journalist and successful science writer. This is his seventh book which is an unusual mixture of a novel, a popular science book about quantum physics, and a biography of Gerolamo Cardano (1501-1576). The general public knows Cardano from the Cardan shaft in their car, although this idea of the universal shaft is much older and Cardano only mentioned the gimbal in his books.



Michael Brooks

Since 2015, Cardano is also the name of a network used to distribute the Ada cryptocurrency, named after Ada Lovelace. Among mathematicians, Cardano is most famous for his dispute with Tartaglia about the publication of a formula to solve the cubic equation. Cardano was the illegitimate son of a respected jurist and mathematician, and so his mother had tried to abort him. He was often sick as a child but he survived the plague to which all of his siblings perished.



Gerolamo Cardano

He studied medicine in Milan and Padua. To earn some money after his father died he gambled and so derived the principles of probability theory. With the formulas to compute the solutions of the cubic, he at least implicitly used the square roots of negative numbers and thus contributed to the foundation of complex analysis. Because he was rather outspoken, he was not a beloved person, but he was an excellent physician, and became a well respected professor of mathematics consulted all over Europe. His youngest son was a gambler and a thief so that he had to disinherit him and his oldest son got sentenced to death for poisoning his wife. Add to this Cardano's character and jealousy from

colleagues so that after he had cast a horoscope of Christ, he fell from grace and was imprisoned by the inquisition at the age of 69. Eventually released he moved to Rome where he compiled his autobiography in which he wrote that there was a guardian angel visiting him in prison.

In this novel Brooks breaks into Cardano's prison to join him. He plays the role of this guardian angel, and while having a conversation with Cardano, he explains the principles of quantum theory to him. Not unreasonable because Cardano laid the foundations of both complex numbers and of probability, the essential ingredients of quantum physics. We, as the reader, learn not only about the eventful life of Cardano, but are also instructed about the basics and the mysteries of quantum theory. Brooks gives not only the classical Copenhagen interpretation of the quantum phenomena, but includes a sizable survey of all the other possible interpretations that have been given.

This mixture makes this book unique. It reads like a novel, and Brooks smuggles in some surprising twists, because he comes from the future and thus knows facts that Cardano does not, but there are also private facts that Brooks asks Cardano that he pretends not to know, or things that he just guessed because they were not in the biographies about Cardano that he has read. So there is some element of a fantasy and a Sci-Fi story in it too. Brooks explains this impossible meeting by presenting it as a quantum physical entanglement of two personalities that can stretch over time and space. Perhaps in a century from now we shall look upon our understanding of quantum theory just as we now look upon Cardano's astrology as being unscientific.

Brooks has written several popular science books with a more classical structure about quantum theory and probability, about mysteries in cosmology and life sciences, and about science and fiction in fantastic movies. This book however stands out with its unprecedented composition. A recommended read.

Adhemar Bultheel

13 Things That Don't Make Sense. The most intriguing scientific mysteries of our times by *Michael Brooks*. Doubleday, 2008 (256 p.) isbn 978-1-861978-17-2

Reading *The quantum astrologer's handbook* (2017) by Michael Brooks, made me look at some of his previous books, and although already 10 years old, and not directly involving a lot of mathematics, I believe this one is still interesting to read.

It discusses scientific facts for which we do not have a proper explanation. It makes you as a scientist humble and it makes you realize that we still understand only very little about the ourselves and the world we live in. But on the other hand, the Big Bang is assumed to have happened 13.8 billion years ago and the Earth came about 4.500 million years ago. It took then a period of 4.000 to 540 million years to have elementary forms of life evolve to a more complex form, and the Homo Sapiens dates back about 300.000 years. So we have come a long way in a relatively short time, while progress seems to be growing exponentially. Thus there is good hope that we shall soon find answers to all the questions raised here. In fact some progress was made already in the last decade.

The subjects can be subdivided into physics and life sciences. To give a flavour of what is being discussed, I will quickly scan some of the 13 chapters.

- *The missing universe.* This is about the fact that only 4 percent of the mass in our universe is visible. It was the reason that Einstein introduced his cosmological constant, which he later called his biggest mistake. The current generally accepted explanation is that the rest consists of dark matter. There are several theories but as yet nobody properly understands what it actually is.
- *The pioneer anomaly.* The Pioneer 10 & 11 spacecrafts launched in the 1970's deviated from their acceleration predicted on the basis of gravitation theory. This was still a mystery and the source of many speculations in 2008 which are described by Brooks, but since 2012 it has been explained by an anisotropic radiation pressure caused by the spacecraft's heat loss. There are however still some issues that are not completely explained by this thermal solution.
- *Varying constants.* This is about the fine-structure constant in physics usually indicated by α and which is approximately 1/137. It is fundamental in quantum electrodynamics, as are some other constants, and thus defines everything that is derived from this, including our understanding of the whole cosmos as it has evolved in the past, and what its future will be. But what if these constants are actually slowly varying? Then cosmology would need to be rewritten.
- *Cold fusion.* This was a highly researched subject since Fleischmann and Pons announced this in 1989, but since their experiment could not be reproduced, it ruined their career. Although of primal interest in view of our increasing need for alternative sources of energy, no successes have been booked since and the exploration of the possibilities has faded away.
- *Life.* Several of the remaining chapters are more related to life sciences and biology, like this one about the origin of life on Earth. Many books appeared recently because of our improved understanding of DNA and cell biology. One of the more recent books with some interesting insightful views is *The vital question* by Nick Lane (1915). It has much more details than is in this chapter, but it is harder to read since it requires some deeper understanding of cell biology. If you are not familiar with the subject, then this chapter may be a place to start before starting the Lane book.
- *Viking.* Is about the search for life on Mars. It was only in March 2018 that it was announced

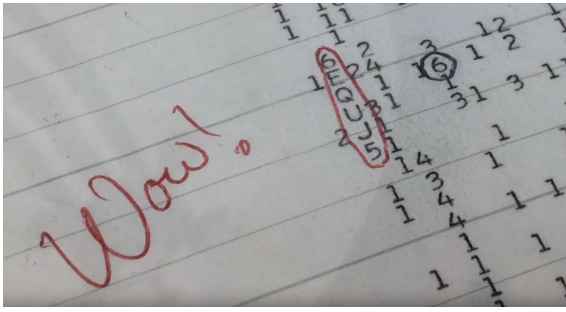


Michael Brooks



$$\alpha = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c}$$

that a substantial lake of liquid water was detected below the ice cap of the south pole by ESA's Mars Express orbiter.



The Wow! signal

- *The wow! signal.* When in 1977 the radiotelescope Big Ear was probing the universe for 'messages from extraterrestrials', its hard disk was printed out and erased, but when Jerry Ehman checked the listing several days later, he detected some high energy signal indicated by the string 6EQUJ5, and he wrote Wow! in the margin. That was an unusual signal sticking out of the noise. But even though many planets in the goldenlocks zone of stars have been detected since, no other such signal or other contact has ever been observed.

Whether there is any life form 'out-there' is still a subject of speculation.

- *A giant virus.* The mimivirus (a mimicking microbe) was detected in 1992, and originally mistaken to be a bacterium. It was the largest one detected until 2011 when an even larger one was described. Is it to be placed on the boundary between living and non-living, which required to redraw the tree of life. It may be related to DNA that existed before cellular organisms, or it may be the remainder of a different type of DNA (besides eukaryotes and prokaryotes like archaea and bacteria).

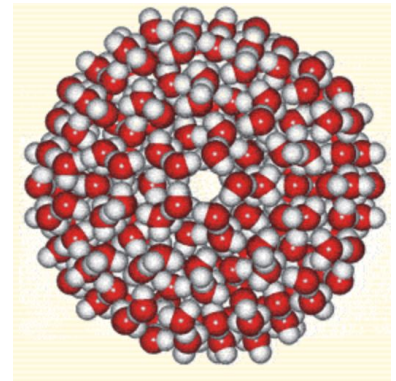
- *Death.* This is about gerontology or rather bio(medical)gerontology. So far our life span has been extended by mitigating the diseases of aging. But there are many theories that explain why we age and catch these diseases. Telomeres at the end of chromosomes diminish after reproduction. When there are no more, the cell will die. Cancer cells reproduce telomeres. Can we re-engineer our cells to prevent them from dying or is there a natural limit? Life evolved so quickly because it used oxygen to burn sugars in eukaryote cells. But oxygen is toxic, which evolution counteracted by introducing sex which entailed more lethal threats. Green plants live on photosynthetic prokaryotes that produce oxygen as waste and therefore live longer.

- *Sex.* Why did sex arise in the reproduction process, while it is so much more efficient to just reproduce by cloning? Several hypotheses exist. Selection of a partner on the basis of producing the fittest offspring may be one of them, but it could also be a selection for the benefit of the group. About the origin of sexual reproduction you might also want to read Lane's book.

- *Free will.* How much of a free will do we have if everything has to follow physical, biological and chemical laws? Neurological experiments showed that a decision is made in our brains before the moment that we think that we actually decide. Curiously enough, since Brooks has a background in quantum physics, he does not refer to the fact that there is something like quantum physical uncertainty contradicting determinism.

- *The placebo effect.* A placebo is never completely a placebo. The sight of a needle or just taking a pill, may already have an effect on our expectations, or have a nocebo effect. It could be a matter of conditioning, but anyway our reaction to a placebo is not fully understood, since it has a measurable effect that cannot be explained.

- *Homeopathy.* Every right hearted scientific mind will claim with certainty that homeopathy cannot work, but can it have a placebo effect, and if so how does it work? Further research shows that we do not know everything about liquid water. Water is essential for life and DNA, and according to Martin Chaplin the organization of water in larger icosahedral clusters may be of importance and this could be modified by just one molecule.



An $(\text{H}_2\text{O})_{280}$ icosahedral cluster

Adhemar Bultheel



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des Sciences

UMONS
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Karl GROSSE-ERDMANN –
Quentin MENET

JOURNEE ORGANISEE AVEC LE SOUTIEN DE
L'EDT MATH

Services d'Analyse Mathématique et de Probabilités et Statistique

- 10h30** **Gilles Godefroy**
(Sorbonne Université, Paris)
Limites simples de fonctions continues et applications
- 14h00** **Colin Petitjean**
(Université Gustave Eiffel, Marne-la-Vallée)
Propriétés des espaces l_p et classification

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Le Pentagone – Salle 0A11/rez-de-chaussée
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Invitation cordiale à tous

GAME2020

GEOMETRIC ALGEBRA

26-28 Feb 2020
campus "The Level" - DAE Kortrijk



Are You **GAME**?

<https://bivector.net>

• Complex numbers • Quaternions • Spinors • Versors • Rotors •
• Dual Quaternions • Lie Groups • Lie Algebras • Exterior Algebra •
e - No Prerequisites - Free Entrance - No Prerequisites - Free Entrance - No Prerequisites

PROGRAM

WEDNESDAY 26 Feb

- 9:30 **Steven De Keninck** **Dual Quaternions Demystified**
AGL
In this hands-on lecture, Steven will demystify the dual quaternions, making sure you walk out knowing exactly where to get cheap $se(x)$! (plus you'll know what that means.)
- 14:00 **Dr. Leo Dorst** **Get Real!**
University of Amsterdam
Author GA4CS
In this talk, first given at CNMAC2019, Dr. Dorst explores the connections between linear and geometric algebra. Join him and discover how GA can spice up your LA skills!

THURSDAY 27 Feb

- 9:30 **Hugo Hadfield** **Robots, Ganja and Easy Screws**
Eric Wieser
Cambridge, Numpy
Join Hugo and Eric as they explore Conformal Geometric Algebra and the kinematics of mechanisms. Find out how to make your robots conform!
- 14:00 **Prof. Anthony Lasenby** **A new language for Physics**
Cambridge University
Author GA4PHYSICISTS
Discover the framework that unifies the mathematics of gravity, and the strong, weak and electromagnetic forces, using the geometric algebra of 4-dimensional spacetime.

FRIDAY 28 Feb

- 9:30 **Dr. Vincent Nozick** **Geometric Neurons**
Dr. Stephane Breuils
UPEM Paris, NII-JFLI Tokyo
Join Dr. Nozick and Dr. Breuils as they explore how deep learning and AI can meet geometry and serve each other.
- 11:00 **Dr. Dietmar Hildebrand** **Workshop GAALOPWEB**
TU Darmstadt
Join Dietmar for a hands-on workshop on using GaalopWEB for optimized Geometric Algebra code in a wide variety of programming languages.
- 14:00 **Dr. Charles Gunn** **PGA Salad**
Raum+Gegenraum
Mix familiar themes (dual construction, the ideal norm) with new ones (non-euclidean geometry, rigid body mechanics), season with history and interactive demos, serve immediately.