INFOMAT

SEPTEMBER 2024

HØSTSEMESTERET ER I GANG!

INFOMAT kommer ut med 11 nummer i året og gis ut av Norsk Matematisk Forening. Deadline for neste utgave er alltid den 15. i neste måned. Stoff til INFOMAT sendes til

arnebs at math.uio.no

Foreningen har hjemmeside http://www.matematikkforeningen.no/
Ansvarlig redaktør er Arne B. Sletsjøe, Universitetet i Oslo

Matematisk kalender

2025

Januar:

13.-17. QUANTUM GROUPS, TENSOR CATEGORIES AND QUANTUM FIELD THEORY, Oslo
<https://www.mn.uio.no/math/english/research/groups/operator-algebras/events/conferences/qg-2025/index.html>

Nye doktorgrader

Eiolf Kaspersen ved NTNU forsvarte 30. august 2024 sin avhandling *On the Thom morphism for Lie Groups* for graden PhD.

Veiledere har vært Gereon Quick (hoved-) og Markus Szymik (bi-), begge NTNU.

Erlend Bergtun ved NTNU forsvarte 19. september 2024 sin avhandling *Algebraic Methods in Analysis and Topology* for graden PhD.

Veiledere har vært Markus Szymik (hoved-) og Gereon Quick (bi-), begge NTNU.

Sammendrag:

This thesis consists of two parts. Part I concerns the classification of unital minimal A_∞-structures on graded vector spaces concentrated in degree 0, 1 and 2 up to equivalence. Here we give a complete description of every possible unital A_∞-structure on such vector spaces, and partial results on the question of equivalence between such structures.

We find an invariant of equivalent minimal A_∞-structures, namely we prove that the first non-zero multiplications have to be equal up to automorphism. In particular, the integer where this happens is a discrete invariant of an A_∞-structure, and it can take any value from 2 to ∞. We also give an example where this invariant gives a complete answer to the question of equivalence. In part II we show how to solve partial differential equations in the representation coefficients of a projective unitary representation of a Lie group. To do this we build up a theory which allows us to differentiate the representation itself. We then apply this to the case when the Lie group has a left-invariant complex structure to get holomorphic representation coefficients.

Davide Murari ved NTNU forsvarte 25. september 2024 sin avhandling *Neural Networks, Differential Equations, and Structure Preservation* for graden PhD.

Veiledere har vært Elena Celledoni(hoved-) og Brynjulf Owren (bi-), begge NTNU.

Kunngjøringer

ICM 2026

Dear colleagues

The Program Committee (PC) for the International Congress of Mathematicians 2026 in Philadelphia, USA, 23–30 July 2026, has been established. At this moment in time the Adhering Organizations of the IMU and mathematical societies worldwide are invited to nominate plenary and sectional speakers.

I refer to section 4 of the 2023 report of the ICM Structure Committee, which lists the ICM 2026 sections as proposed by the ICM Structure Committee and endorsed by the IMU Executive Committee (see CL 8/2023). When you make nominations for speakers, please specify whether you suggest them as plenary speakers or sectional speakers. In case of proposals of sectional speakers, please indicate to which sections you would like the persons to be invited. Shared lectures between sections are also possible.

As a reminder, the IMU Executive Committee also endorsed the proposal to leave 20 sectional talks, and one or two plenary talks, to be assigned to special lectures (described in section 3.3 of the report). Nominations for these talks are also invited.

All communication concerning the scientific program of ICM 2026 is handled by the Chair of the Program Committee, Claire Voisin. Please direct all your proposals for invited plenary and sectional speakers to Claire Voisin using the email address <chair@pc26.mathunion.org>.

Nominations should be received by the PC Chair no later than **1 November 2024**.

Christoph Sorger,
Secretary General of the IMU

Dear colleagues

It has been a longstanding tradition that the organizers of the ICM offer support in order that mathematicians from developing countries can participate at the ICM. For ICM 2026 in Philadelphia, USA, the organizers have announced the following grant program:

ICM 2026 Travel Support Program

With generous funding from the Simons Foundation and in collaboration with the IMU and the IMU´s Commission for Developing Countries (CDC), the American Mathematical Society (AMS) is offering travel support for ICM 2026 participants that will provide partial support for mathematicians from eligible developing countries to attend the ICM.

The application deadline is **20 November 2024 (11:59 pm EST).** Applicants will be notified of their application status by 31 March 2025. Further information can be found on the ICM 2026 website.

CALL FOR PROPOSALS FOR 2026 CIMPA SCHOOLS

(flere detaljer på <www.cimpa.info>)

Arrangementer

QUANTUM GROUPS, TENSOR CATEGORIES AND QUANTUM FIELD THEORY, Oslo 13.-17. januar 2025

Quantum field theory has been for a long time a big driving force in many areas of mathematics. In particular, it stimulated a fruitful study of mathematical structures that can represent many-body quantum mechanical systems, such as quantized universal enveloping algebras, inclusions of operator algebras and tensor categorical structures governing them, which are also interesting for their own sake. This workshop aims to bring together international experts on these topics, stimulate further exchanges of research ideas, and give an opportunity for young members of our research community to be exposed to the rapidly evolving research at the top level.

David Jaklitsch, Sergey Neshveyev and Makoto Yamashita

Nyheter

Mathematicians Discover New Shapes to Solve Decades-Old Geometry Problem

Mathematicians have long wondered how “shapes of constant width” behave in higher dimensions. A surprisingly simple construction has given them an answer.

Artikkelen er sakset fra Quanta Magazine, skrevet av Gregory Barber

In 1986, after the space shuttle Challenger exploded 73 seconds into its flight, the eminent physicist Richard Feynman was called in to find out what had gone wrong. He later demonstrated that the “O-ring” seals, which were meant to join sections of the shuttle´s solid rocket boosters, had failed due to cold temperatures, with catastrophic results. But he also discovered more than a few other missteps. Among them was the way NASA had calculated the O-rings´ shape. During preflight testing, the agency´s engineers had repeatedly measured the width of the seals to verify that they had not become distorted. They reasoned that if an O-ring had been slightly squashed – had become, say, an oval, instead of maintaining its circular shape – then it would no longer have the same diameter all the way around.

These measurements, Feynman later wrote, were useless. Even if the engineers had taken an infinite number of measurements and found the diameter to be exactly the same each time, there are many “bodies of constant width,” as these shapes are called. Only one is a circle.

Arguably the best known noncircular body of constant width is the Reuleaux triangle, which you can construct by taking the central region of overlap in a three-circle Venn diagram. For a given width in two dimensions, a Reuleaux triangle is the constant-width shape with the smallest possible area. A circle has the largest.

In three dimensions, the largest body of constant width is a ball. In higher dimensions, it´s simply a higher-dimensional ball – the shape swept out if you hold a needle at a point and let it rotate freely in every direction.

But mathematicians have long wondered if it´s always possible to find smaller constant-width shapes in higher dimensions. Such shapes exist in three dimensions: Though these Reuleaux-like blobs might look a bit pointy, sandwich them between two parallel planes and they will roll smoothly, like a ball. But it´s much harder to tell whether this is true in general. It could be that in higher dimensions, the ball is optimal. And so in 1988, Oded Schramm, then a graduate student at Princeton University, asked a simple-sounding question: Can you construct a constant-width body in any dimension that is exponentially smaller than the ball?

Now, in a paper posted online in May, five researchers – four of whom grew up in Ukraine and have known each other since their high school or college days – have reported that the answer is yes.

The result not only solves a decades-old problem, but gives mathematicians their first glimpse into what these mysterious higher-dimensional shapes might look like. Although these shapes are easy to define, they´re surprisingly mysterious, said Shiri Artstein, a mathematician at Tel Aviv University who wasn´t involved in the work. “Any new thing we learn about them, any new construction or computation, is at this point interesting.” Now researchers can finally access a corner of the geometric universe that was once completely unapproachable.

Andrii Bodarenko, NTNU

Andrii Arman and Danylo Radchenko met in the mid-2000s at a math-focused high school in Kyiv and were also teammates on Ukraine´s competitive Math Olympiad squad. They became friends, but didn´t stay in close touch. When their mathematical work later pulled them independently into the orbits of both Andriy Prymak and Andrii Bondarenko – who had attended Kyiv National University together in the 1990s – they reconnected. The four mathematicians have since moved to different cities around the world and pursued different research programs, but they gather twice a week over Zoom to work together on tough geometric proofs.

Constant-width shapes were not initially on the agenda. Last year, the group was instead trying to answer a related question called the Borsuk problem, which had stumped prominent mathematicians for over a century. But an idea kept popping up during their meetings: When Schramm posed his question about constant-width bodies in the 1980s, he also suggested that understanding such shapes might provide a way to tackle the Borsuk problem.

The Ukrainian mathematicians had been pursuing a different approach, and some of them were reluctant to change focus. But Bondarenko, now at the Norwegian University of Science and Technology, insisted that they try, even if it didn´t help them directly. “He was always emphasizing that the problem is important in its own right,” said Arman, who is currently a postdoctoral researcher at the University of Manitoba. Eventually, the rest of the team agreed to make the attempt.

To understand what they did, it helps to think back to the Reuleaux triangle in two dimensions. Say you want to build a Reuleaux triangle of a given width. First draw an equilateral triangle – what the mathematicians call a seed. Choose a point on the triangle´s boundary and draw a circle around it with a radius equal to the width you want the final shape to be. Now do this at every point on the triangle´s boundary, so that you get a set of infinitely many circles.

Look at the region where those circles overlap. Somewhere within it, you´ll be able to find a body of constant width – you just have to figure out which subset of your seed you actually need. In this case, you can look at just the three vertices of the equilateral triangle, rather than all the points on its boundary. Draw circles around those three points, and you´ll get a Venn diagram; its overlapping region is the Reuleaux triangle.

In higher dimensions, it´s possible to use the same approach. Start with a set of points: your seed. Draw a ball around each point, take their intersection, and look for the body of constant width that lives inside that new space. But it´s much harder in high dimensions to figure out what subset of your seed will give you the shape you want.

Arman, Bondarenko, Prymak and Radchenko experimented with different seeds and eventually came up with a particular curve they wanted to use. They knew that this curve would give them a region that contained a sufficiently small body of constant width. But they wanted to understand what the constant-width body itself would look like. As they searched for an answer, Arman came across a post from 2022 on the question-and-answer site MathOverflow. The poster, Fedor Nazarov of Kent State University, had been independently trying to answer Schramm´s question, and his approach looked remarkably similar to the Ukrainian team´s, though he´d gotten stuck. The quartet invited him to join them. It was then that Nazarov realized something that the rest of them had missed: The shape their seed gave them did not just contain a constant-width body. It was one.

Their work provides a surprisingly simple algorithm for building an n-dimensional shape of constant width whose volume is at most 0.9n times that of the ball. That limit is, in a sense, arbitrary, Arman said. It should be possible to find even smaller bodies of constant width. But it is enough to answer Schramm´s question, proving that as the number of dimensions increases, the gap between the volumes of the smallest and largest constant-width bodies grows exponentially. Despite the complex ideas behind their result, Arman said, their construction is something undergraduates should be able to verify.

For Gil Kalai of Hebrew University, there is personal satisfaction in seeing an answer for Schramm, his former student, who died in 2008 in a hiking accident after making significant advances on questions in many different fields. But Kalai is also excited to explore the theoretical consequences of the result. Previously, he said, it was possible that in higher dimensions, these shapes would all simply behave like balls, at least when it came to the property of volume. But “this is not the case. So this means that the theory of these bodies in high dimensions is very rich,” he said.

That theory might even have applications. In lower dimensions, after all, bodies of constant width are already surprisingly useful: The Reuleaux triangle, for example, shows up in the form of drill bits and guitar picks and tamper-proof nuts for fire hydrants. According to Arman, in higher dimensions, their new shapes might be useful in the development of machine learning methods for analyzing high-dimensional data sets. Bondarenko – known within the group for what Arman calls his “crazy ideas” – has also proposed connections to distant branches of mathematics.

The search for the smallest possible body of constant width – which remains open in all dimensions greater than 2 – continues. The group briefly used their construction to investigate one promising candidate in three dimensions, but it let them down: It turned out to be a tiny fraction of a percent larger than the smallest known body. For now, the mathematicians have decided to give up the chase and return to their work on Borsuk´s problem. In their wake, they´ve left behind a world of new high-dimensional shapes for others to explore.

MATEMATIKK EN BÆREBJELKE I MODERNE DEMOKRATIER

Av Frankrikes ambassadør til Norge – tidligere forsker og fysikklærer Florence Robine. Innlegget er sakset fra Khrono og er en omarbeidet versjon av et foredrag ambassadøren holdt på Universitetet i Oslo 11. september 2024.

Som ambassadør og tidligere forsker og fysikklærer tenker jeg ofte på de dype og ukjente koblingene mellom disse yrkene. Mange av våre medborgere, og kanskje til og med våre beslutningstakere, er kanskje ikke helt klar over det. Derfor er det verdt å påpeke at matematikken er overalt, og at den nå er avgjørende for å takle vår tids utfordringer.

Den første av dem, den som skremmer oss og den yngre generasjonen mest: klimaendringene. Matematisk modellering på dette området er per i dag det grunnleggende verktøyet for å bygge og evaluere ulike scenarioer for utviklingen av jordkloden under påvirkning av en temperaturøkning på $1,5^oC$, 2^oC eller mer, og for å måle de mulige effektene knyttet til energiomstilling. Det fikk jeg selv oppleve i vår under en reise til Svalbard sammen med den tidligere franske ministeren for høyere utdanning og forskning. Vi fikk anledning til å snakke med mange forskere om de digitale modellene av planeten vår, som hjelper oss til å forstå sammenhengen mellom atmosfæren, havene, isbreene, vegetasjonen, plastforurensning og biologisk mangfold.

I dag er det matematikk, basert på data innhentet fra andre vitenskapsfelt, som er retningsgivende for studier om plastforurensning i havene eller utviklingen av det biologiske mangfoldet i verden

Dette forklarer gjennombruddet av vitenskapsdiplomatiet. Det kan defineres som direkte eller indirekte bruk av vitenskap, kunnskap og vitenskapelig samarbeid for å fremme diplomatiske målsettinger.

Det er et nytt område innen internasjonale relasjoner, der vitenskap ikke lenger bare er et diskusjonstema, men har blitt et verktøy som internasjonale institusjoner som Europakommisjonen ønsker å utvikle videre for å fremme vitenskapsbaserte beslutninger.

Matematikk kan faktisk bidra til å endre vårt tankesett helt, noe som har store samfunnsmessige og politiske konsekvenser. Kunstig intelligens er for eksempel i ferd med å omdefinere verden fullstendig. Politiske beslutninger basert på fakta, for eksempel satellittbilder som viser sosioøkonomiske indikatorer som fattigdom og velstand rundt om i verden, er også avgjørende for å nå bærekraftsmålene, som ble vedtatt av FN i 2015, innen 2030.

Visste du også at matematikk kan hjelpe oss med å tenke nytt om demokratienes fremtid og deres viktigste grunnmur: valgsystemene?

Fascinerende forskning viser for eksempel at kandidaten som går seirende ut av et valg avhenger av valgsystemet som brukes (én eller to valgomganger), av proporsjonal representasjon, av antall valgomganger og størrelsen på valgkretsene. Til slutt er det ikke alltid kandidaten med flest stemmer som vinner.

1. Folkemeningen. Vi må endre oppfatningen av matematikk og naturvitenskap ved å vise at disse fagområdene er overalt, at de er helt sentrale i spørsmål som angår oss alle, og at de er viktige verktøy for å sikre menneskehetens fremtid. Det krever mer synlighet for disse fagene, samt bedre formidling av kunnskap og bedre opplæring av lærerne. Verden står overfor politiske hindre for å implementere effektive løsninger på globale problemer fordi tilliten til vitenskapen er i ferd med å minke. Da er det på tide å utvikle tverrfaglige tiltak, for eksempel i samarbeid med samfunnsvitenskapelige displiner, for å gi forståelse og bevis til støtte for ulike beslutninger, og skape et bedre samspill med politikere og samfunnet generelt.

2. Vi må selvsagt også endre måten elevene og studentene lærer matematikk på. I Frankrike betraktes matematikk som et allment fag og et kommunikasjonsmiddel. Matematikk er ikke bare et fag hvor sannheter blir fastsatt uten diskusjoner. Det er også en arena for å bli kjent med nye uttrykksformer: tall, figurer, grafer, formler, tabeller osv. Med matematikk lærer man å skape konsensus om sannheten basert på fakta, og å tydelig formulere påstander.

Hva tjener samfunnet og demokratiet bedre enn matematikk når målet er å skape en informert offentlig debatt basert på fakta og andres meninger slik at man sammen kan fatte beslutninger?

Vi må alle møte disse utfordringene sammen: studenter, lærere, forskere, økonomiske aktører og politikere. Så la oss sette i gang dette arbeidet nå!