INFORMATION, COMMUNICATION & COMPUTING

Fields of Expertise TU Graz

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Kay Uwe Römer,
Information, Communication & Computing
Source: Lunghammer – TU Graz

The second TU Graz Science Day will take place on September 21, 2022. This year the focus is on Digitalization, so the FoE ICC in particular will be playing a leading role. The opening keynote will be given by Lothar Thiele, who is not only a leading researcher, but as the "delegate for digital transformation" of ETH Zurich and one of the initiators of the ETH AI Center, is a leading expert on digitalization. In the afternoon, FoE members will organize sessions with invited presentations of colleagues on a topic related to digitalization. Also, an exhibition is planned, to which FoE members can contribute a poster or demonstrator. It is well worth the effort as we expect around 200 visitors from industry, academia, funding bodies, and politics who are keen to see our research and to get in touch. The day after, on September 22, 2022, the final event of the LEAD project Dependable Internet of Things will be held – the first LEAD project funded by TU Graz whose six-year funding period is now coming to a close. The event will showcase the results obtained during six years of intense research and collaboration. You are all cordially invited to contribute to and participate in these two collocated events; please make a note of these dates in your calendars.

In this edition of TU Graz *research*, Cesar Ceballos, postdoc at the Institute of Geometry, shares his *research* on combinatorics and discrete geometry with us. Enjoy reading! ●
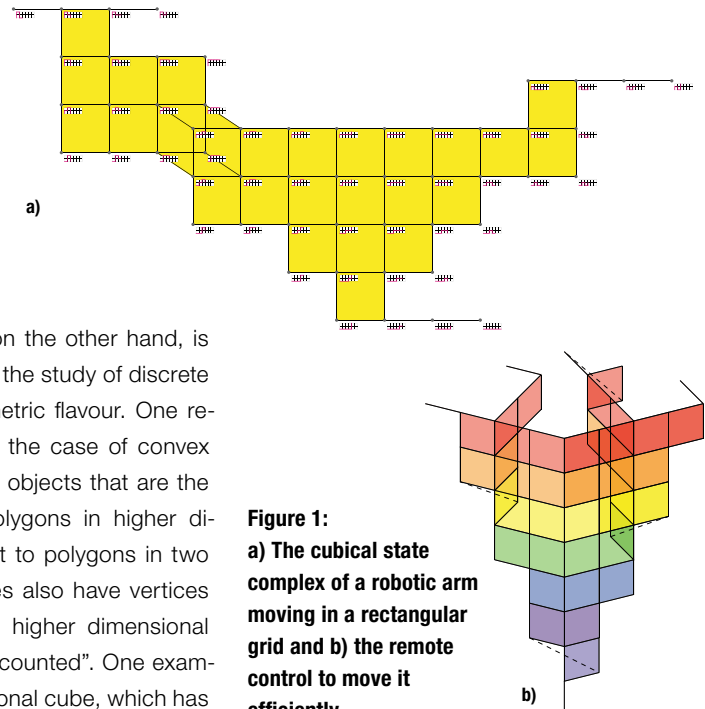
Cesar Ceballos

Combinatorial and Geometric Structures

It is widely recognised that many of the most exciting advances in mathematics rely on building connections between various areas of research, with ideas from one field enriching those of another. Ceballos's research builds on the fruitful interaction between combinatorics and discrete geometry, and focuses on problems motivated by their connections to other fields.

Combinatorics is an active area in mathematics that deals with the study of discrete structures. Rather than "continuous", discrete structures are built from objects that can be "counted". This simple but important feature is key for applications to real-world problems, where discrete models can be implemented. Examples include scheduling problems, railway planning, networks, cell phone communications, Google Maps, developing of computer algorithms, and many more.

Discrete Geometry, on the other hand, is a field that deals with the study of discrete structures of a geometric flavour. One remarkable example is the case of convex polytopes, geometric objects that are the analog of convex polygons in higher dimensions. In contrast to polygons in two dimensions, polytopes also have vertices and edges, but also higher dimensional faces which can be "counted". One example is a three dimensional cube, which has eight vertices, twelve edges, and six >

Figure 1:
a) The cubical state complex of a robotic arm moving in a rectangular grid and b) the remote control to move it efficiently.
Source: Federico Ardila and Cesar Ceballos