Embracing complexity

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Mathematicians from more than a dozen countries will gather at Case Western Reserve University next week to discuss the theoretical world of high dimensions.

While we live in a three-dimensional world, in this discipline, mathematicians work with thousands, millions, billions of dimensions - even dimensions approaching infinity.

The conference, Aug. 2-6, is the culminating event of a three-year National Science Foundation Focused Research Group grant, led by Stanislaw Szarek and Elisabeth Werner, CWRU mathematics professors. Other institutions participating in the project are Kent State University, the University of Michigan and the University of Missouri. The funding, in the amount of $1.4 million, is being used primarily to facilitate interaction among the researchers at the participating institutions and to support graduate students in this subfield of mathematics.

For Werner, mathematics provides the basis for expressing abstract contents: mathematicians develop a language that allows them to express the thinking process in a precise form.

The title of the conference "Perspectives in High Dimensions" refers to a relatively new area in mathematics, "Asymptotic Geometric Analysis." In applications, if dimension represents a parameter of a system or phenomenon; high dimensionality appears because "real world" phenomena are complex and cannot be fully described by just a few numbers.

In general, as dimension increases, the difficulty of sampling and computation go up rapidly, a phenomenon scientists and mathematicians sometimes call "the curse of dimensionality." However, there are also patterns that emerge as dimension increases, and this is exactly what Asymptotic Geometric Analysis investigates.

For example, as dimension increases, a geometrical structure does not necessarily become more chaotic, but often regularity emerges, explain Elizabeth Meckes and Mark Meckes, CWRU math professors and members of the local conference organizing committee. One might even talk about the "blessing of dimensionality."

Over the last several years, this area of mathematics has grown rapidly and the methods developed there have found many applications: from facial recognition computer programs to quantum computing, statistics to probability.

Next week, researchers and students will hear speakers from around the world present their findings on the geometry of high-dimensional spaces, properties of large matrices, modeling complex sensor networks, methods of reducing the high dimensionality of data and analyzing the information, and much more.

Provided by Case Western Reserve University