Little is known about the biological causes for psychiatric disorders like schizophrenia and bipolar, which combined afflict an estimated 10 million people nationwide. Columbia researchers are working hard to change that by exploring the role of genetics from a multidisciplinary approach.

Electrical engineering professor Dimitris Anastassiou’s aim is to discover novel biological mechanisms responsible for psychiatric disorders. Given the limited success of identifying significant individual risk-conferring genetic variants, such as single mutations in DNA, Anastassiou says discovery of responsible interactions among multiple genetic variants may reveal new disease mechanisms.

Anastassiou and Maria Karayiorgou, professor of psychiatry and medical genetics at the Columbia University Medical Center, are principal investigators on a project that will identify single nucleotide polymorphisms (SNPs, pronounced “snips”) that are jointly, rather than individually, associated with disease.

A SNP is a small genetic change that can occur within a person’s DNA sequence. The genetic code is specified by the four nucleotide “letters” A (adenine), C (cytosine), T (thymine), and G (guanine). SNP variation occurs when a single nucleotide, such as an A, replaces one of the other three nucleotide letters—in this case C, T, or G.

An example of a SNP is the alteration of the DNA segment AAGGTTA to AAGTTTA, where the fourth letter in the first snippet, G, is replaced with a T. On average, SNPs occur in the human population more than one percent of the time, but, because neighboring SNPs are statistically linked, researchers only need about one million of them to analyze our genomes.

The traditional approach looked only at individual SNPs. Anastassiou’s research investigates the possibility that a person may be predisposed to a disease if two SNPs at different locations in the genome have the unusual letter combinations, rather than each one of them alone, a phenomenon called “synergy.” There is a huge number (about a million squared) of “synergy” pairs of SNPs, resulting in significant computational and statistical challenges for this project. To perform this research, Anastassiou has a high-performance computer cluster containing 800 processors at his disposal.

“The aim is to discover the biological mechanisms responsible for psychiatric disorders,” says Anastassiou. “Once such mechanisms are discovered, the ultimate vision is to develop drugs that would interfere with these mechanisms.”

Anastassiou is a prominent leader in digital technology. His research has resulted in Columbia being the only university in a consortium that licenses MPEG-2, the technique used in all forms of digital television transmission, including DVDs, direct satellite TV, HDTV, digital cable systems, personal computer video, and interactive media.

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Finding the Mechanisms of Psychiatric Disorders

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