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J Genet Disor Genet Rep 2018, Volume 7
DOI: 10.4172/2327-5790-C1-003

2nd World Congress on
BIOINFORMATICS & SYSTEM BIOLOGY
October 15-16, 2018 Dubai, UAE

Quantum-information genetics and new symmetries in long DNA-texts

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Hidden symmetries in long sequences of oligonucleotides of single stranded DNA from their representative set are described. These symmetries are an addition to symmetries described by the second Chargaff's parity rule. These new symmetries and their rules concern collective probabilities of oligonucleotides from special tetra-alphabetical sets in long DNA-texts including all chromosomes of human and some model organisms. These rules of tetra-alphabetical probabilities are considered as candidacies for the role of universal rules of long DNA-sequences. On the basis of the known quantum-mechanic statement that quantum state of a multi-component system is defined by the tensor product of quantum states of its subsystems, a quantum-information model of genetic symmetries of these collective probabilities was proposed. In this model, nitrogenous bases C, T, G and A of DNA were represented as computational basis states of 2-qubit quantum systems. The biological meaning of the new quantum-information symmetries of long DNA-texts can be connected with the common ability of organisms to grow on the basis of incorporation into their body of new molecules of nutrients becoming new quantum-mechanic subsystems of the united quantum mechanical organism. Using known peculiarities of nitrogenous bases A, C, G and T, the interconnected DNA alphabets of 4 monoplets, 16 doublets and 64 triplets are represented in form of square matrices of the tensor family [C, A; T, G](n), n=1, 2, 3. Taking into account the specificity of the degeneration of the genetic code, these symbolic matrices are transformed into numeric matrices with entries ±1 and with Rademacher-Walsh functions in their rows. The author shows that these numeric genetic matrices are sums of sparse unitary matrices with their complementary algebraic interrelationships (unitary matrices are basis of calculations in quantum computers). Deep analogies exist between genetics and quantum computing. From the standpoint of our model approach, the genetic systems are quantum-information essences.

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