Traceability of data stored in DNA, a first biomolecular watermarking scheme

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With the exponential growth of data produced every year, DNA appears as a promising future solution to store information. It has the possibility to be 10^6 times denser than hard drive and could be stored at room temperature for century. However, this new data storage medium also raises new security concerns [1] [2]. In the context, one would like to shares his DNA database with multiple people, there is an interest to trace each copies so that, in the event of a data leak, we can determine which recipient is responsible. To our knowledge, traceability of database stored in DNA has not been studied yet. This problem can be addressed digitally with watermarking [3]. But, this would require to read the database, watermark the data and then physically reencode them in DNA strands, which is not relevant when terabytes are stored. To manage this challenge, we propose the first biomolecular watermarking scheme for DNA data storage. Our scheme originality stands on: a biomolecular substitution to embed a unique identifier in the strands and a novel encoding scheme to store data in accordance with this substitution.

Our protocol relies on two differents substitution of dictionaries, one for writing the data and the other one for reading them. For encoding, each coding DNA sequence is separated by a sequence called spacer. A unique spacer is attributed to the bits of the data where we want to embed the watermark. For our experiment, we synthesized strands using the writing dictionnaries as a succession of patterns corresponding to a pair (data payload and spacer). Substitution for watermarking embedding is then performed using hybridization of staples that are single strand designed such as one extremity bind to the sequence of the writing dictionaries while the other extremities bind to the reading dictionaries. The unbind reading extremities of the staple can finally be used to produce a new strand coding the wateramarked payload. Our method has been tested experimentally to observe whether two different marks can be embedded successfully in two copies of a DNA solution containing an image of 3×4 pixels. The first is watermarked with 10 modifying two pixels and the second with 01.

Bibliography

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