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PROGRAMMABLE BIOMOLECULAR COMPUTING BASED ON CRISPR-CAS: CONCEPTS, COMPUTATIONAL PERSPECTIVES, AND POTENTIAL APPLICATIONS

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ABSTRACT

The CRISPR-Cas system represents an advanced platform for programmable genome editing that enables precise control of DNA cleavage in prokaryotic and eukaryotic cells. Initially demonstrated by programmable in vitro DNA cleavage by Cas9 endonuclease [1], this RNA-guided technology has enabled a wide range of applications in biotechnology and medicine. A notable advancement includes the combination of Cas9 with the *Fok*I restriction enzyme, creating dimeric RNA-guided nucleases with enhanced specificity for targeted genome modification [2].

Currently, DNA computing provides innovative approaches for applying the mathematical foundations of computer science to medicine [3], and enhances the programmability of biological systems [4]. This report introduces conceptual directions for the integration of biomolecular computing technologies [3,4] with CRISPR-Cas systems [1]. Special emphasis is placed on how current biomolecular computation frameworks can guide mathematical modelling and enhance the programmable capabilities of CRISPR-Cas systems. This interdisciplinary integration promises novel applications and innovative solutions, highlighting the role of computational and mathematical approaches in advancing precision medicine.

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