Bidirectional Promoters in Human Genome

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Transcription is the first, decisive phase of the genome expression. Genome transcription (when, where and how) is regulated by RNA polymerases, transcription factors and promoters. Protein coding genes are transcribed by RNA Polymerase II. Promotor is a genome region mainly located before the transcrtion start site, TSS. Previously, it was thought that promoters are unidirectional: they can initiate transcription only on a single strand of DNA. But, recently it was revealed that a single promoter can initiate transcription in both directions. Our project was aimed to explore bidirectional promoters of human protein-coding genes at the genome scale. To date, about 20,000 protein coding genes (PCG) are known in the human genome. The BLAST comparison upstream regions of these genes and human promoters with experimentally validated TSS from EPD revealed that 13753 TSSs belong to the PCGs. For further sudies we selected only these 13753 genes. Using a novel promoter prediction tool TSShmd (Shahmuradov, unpublished), we performed search for CpG, non-CpG/TATA and non-CpG/TATA-less promoters in [-500:+60] regions of these genes. At least, 1 putative promoter (TSS) was found for 11467 genes. For 10021 genes, the predicted promoters are bidirectional and 7470 promoters belong to the CpG class. About 1500 “Head-to-Head” genes at distance less than 1000 bp have putative bidirectional promoter between them. Our results suggest that about half of protein genes have potential bidirectional promoter, mostly of the CpG class. H2H genes with bidirectional promoter were reported to be involved mainly in transcription of genes related to the DNA repair and various cancers. Our results suggest that the bidirectional promoters also regulate transcription of genes involved in other functions.

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