Cellular information processing for time-varying stimulation

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Two important regulatory pathways of NF-κB and MAPK were found to transmit merely one bit of information about the level of constant stimulation with, respectively, TNF and EGF [1,2,3]. This somewhat surprising result may suggest that these pathways evolved to process analog inputs into physiologically interpretable binary outputs. Although being capable of transmitting a single bit about the stimulation dose, both NF-κB and MAPK pathways can respond in a pulsatory manner to the repeated pulses of the stimuli.

Based on computational model [4] we estimated MAPK channel information capacity (or simply bitrate), defined as maximal mutual information that can be transmitted over a sufficiently long time t, dived by t [5]. The MAPK pathway is capable of responding (by activation of kinase ERK) to short EGF pulses of period not shorter than T=60 minutes. As the response is nearly binary, one could expect that the information transmission rate is equal to the classical bandwidth, $1/T$. We found however, that the upper bound on information transmission rate is substantially higher and can be achieved for sequences of EGF pulses with carrying frequency higher than $1/T$. I will discuss this high-frequency coding/decoding for binary input sequences.

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