Short-block LDPC codes are desirable in communication systems in which frame sizes are such that the block sizes are based on protographs (see figure) and circulants. These codes are designed for short blocks, the block sizes being based on maximizing minimum distances and stopping-set sizes subject to a constraint on the maximum variable node degree. In particular, these codes are designed to have variable node degrees between 3 and 5. Short-block codes are desirable in communication systems in which frame-length constraints are imposed on the physical layers. For reasons that, once again, exceed the scope of this article, avoidance of degree-2 nodes enables construction of codes having minimum distance that grows linearly with block size. Limiting code design to the use of variable node degrees \( \geq 3 \) is sufficient, but not necessary, for minimum distance to grow linearly with block size. Increasing the node degree leads to larger minimum distance, at the expense of smaller girth. Therefore, there is an engineering compromise between undetected-error-rate performance (which is improved by increasing minimum distance) and the degree of suboptimality of iterative decoders typically used (which is adversely affected by graph loops).

Codes of the present special type were found to perform well in computational simulations. For example, for a code of input block size of 64, constructed from the protograph in the figure with variable node degrees 3 and 5, the maximum undetected-error rate was found to be \( < 3 \times 10^{-5} \). This maximum was found to occur at a bit signal-to-noise ratio (SNR) of about 1.5, and the undetected-error rate was found to be smaller at SNRs both above and below 1.5, notably decreasing sharply with increasing SNR above 1.5.

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**Short-Block Protograph-Based LDPC Codes**

Characteristics of these codes include low undetected-error rates and low latency.

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