Pseudocode for Gallager codes

Let $\alpha \in (0, \frac{1}{2})$ be the "flip" probability of the channel. Let H be a $m \times n$ parity check matrix for a Gallager code. Let $z \in \mathbb{B}^m$ be the binary vector of parity checks to be decoded, that is, $z \equiv Hu$ where $u \in \mathbb{B}^n$ is the (unknown) noise vector. The objective of the decoding algorithm is to try to recover u from z.

Decoding algorithm

Input: z, H, α

$N_i = \{j : H_{ij} = 1\}$ for $i = 1, \ldots, m$
$M_j = \{i : H_{ij} = 1\}$ for $j = 1, \ldots, n$

Initialize $q_{ij}(0) := 1 - \alpha$ and $q_{ij}(1) := \alpha$ for all i, j such that $H_{ij} = 1$

for $iteration = 1, \ldots, 200$:
    for $i = 1, \ldots, m$:
        $D := (-1)^{z_i} \prod_{j \in N_i} (q_{ij}(0) - q_{ij}(1))$
        for $j \in N_i$:
            $\delta := D/(q_{ij}(0) - q_{ij}(1))$
            $r_{ij}(0) := (1 + \delta)/2$
            $r_{ij}(1) := (1 - \delta)/2$

    for $j = 1, \ldots, n$:
        for $x \in \{0, 1\}$:
            $B(x) := \alpha^x (1 - \alpha)^{1-x} \prod_{i \in M_j} r_{ij}(x)$
        for $i \in M_j$:
            $b(0) := B(0)/r_{ij}(0)$
            $b(1) := B(1)/r_{ij}(1)$
            $q_{ij}(0) := b(0)/(b(0) + b(1))$
            $q_{ij}(1) := b(1)/(b(0) + b(1))$

        $Q := B(1)/(B(0) + B(1))$
        $\hat{u}_j := I(Q > \frac{1}{2})$

    if $H\hat{u} \equiv z$: break

Output: $\hat{u}$