

# Irregular Turbo-Like Codes

Brendan J. Frey

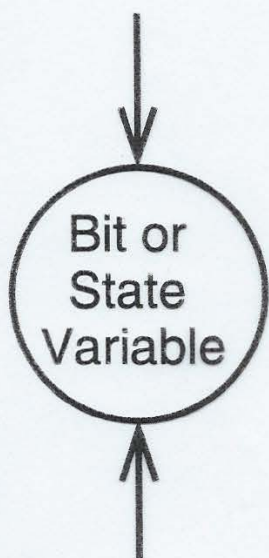
David J. C. MacKay

Suppose you are *told* the values of some bits<sup>v</sup> in a transmitted codeword  
(or states)

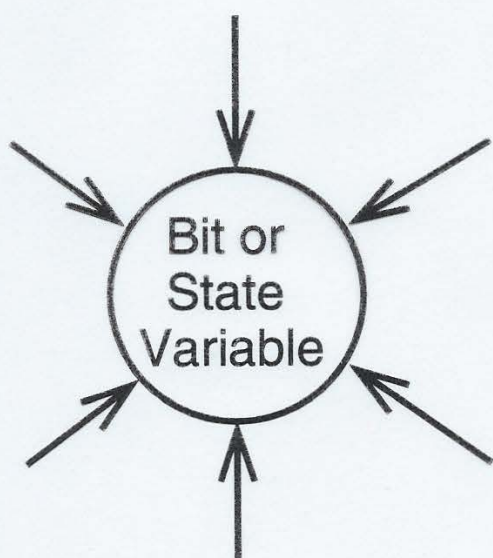
This effectively decreases the rate of the remaining code, making decoding easier

Can we get a free lunch  
out of this?

# Irregular codes: A free bite of lunch



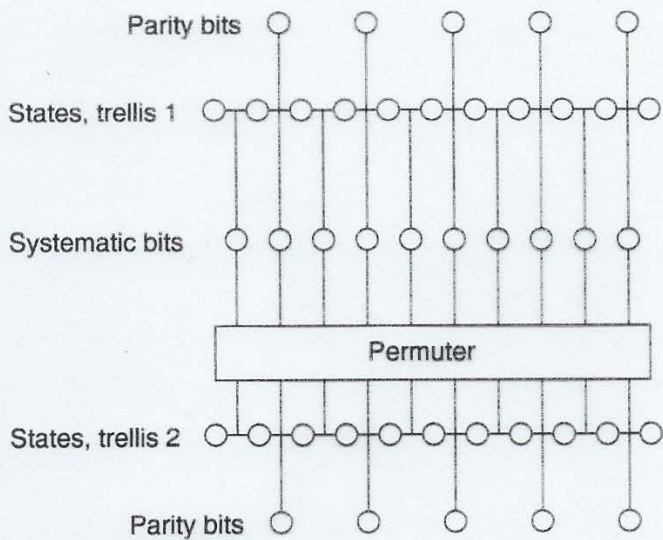
Pinned down SLOWLY



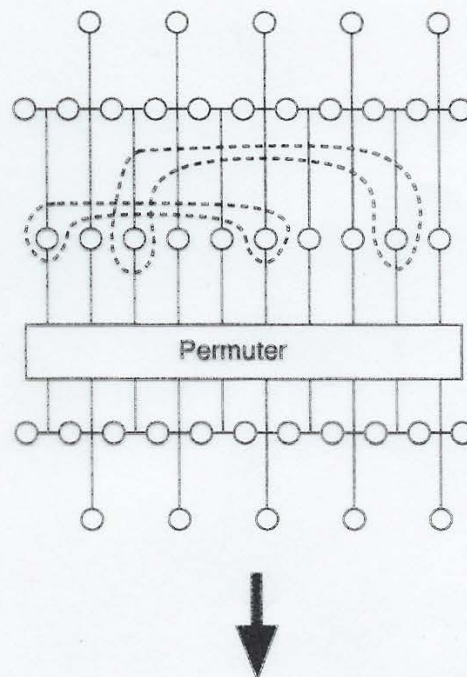
Pinned down QUICKLY!

# "Irregularizing" a turbocode

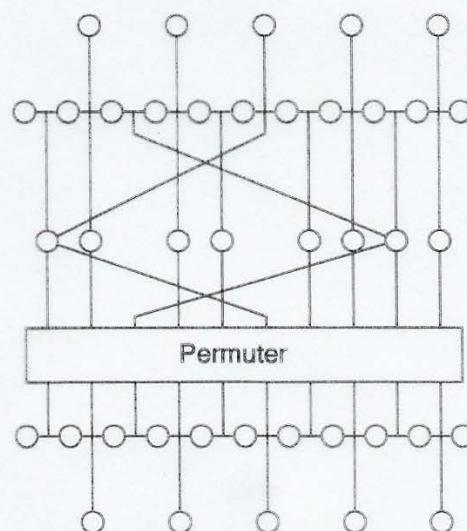
Regular turbocode  $R=10/20$



"Irregularization"



Irregular turbocode  $R=8/18$



## Decoding Irregular TurboCodes

- Sum - Product algorithm

1. Compute channel output LLR's:

$$L_i^o, L_2^o, \dots, L_N^o$$

2. Repeat LLR's appropriately:

If bit  $i$  has degree  $d$ ,

$$L_{i,1} \leftarrow L_i^o, L_{i,2} \leftarrow L_i^o, \dots, L_{i,d} \leftarrow L_i^o$$

3. Revise LLR's using BCJR on trellises:

$$L'_{i,1}, L'_{i,2}, \dots, L'_{i,d}$$

4. Compute MAP estimate for bit  $i$ :

$$\hat{L}_i \leftarrow L_i^o + \sum_{k=1}^d (L'_{i,k} - L_{i,k})$$

5. Compute new inputs to BCJR:

$$L_{i,k} \leftarrow \hat{L}_i - L'_{i,k}$$

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