Ricevitori CFAR incoerenti

Maria S. Greco

Corso di Fondamenti di Radar

Ing. delle Telecomunicazioni

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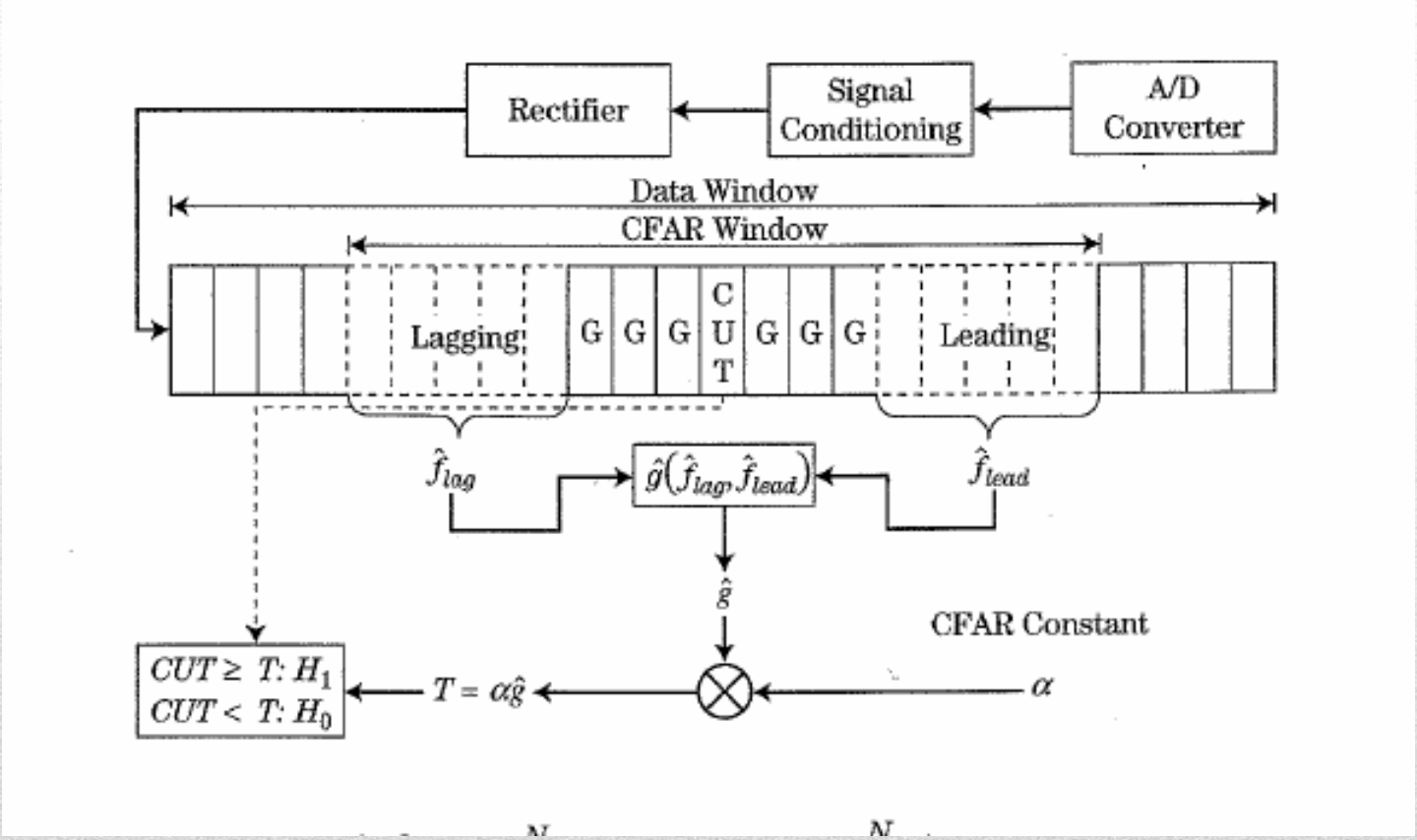
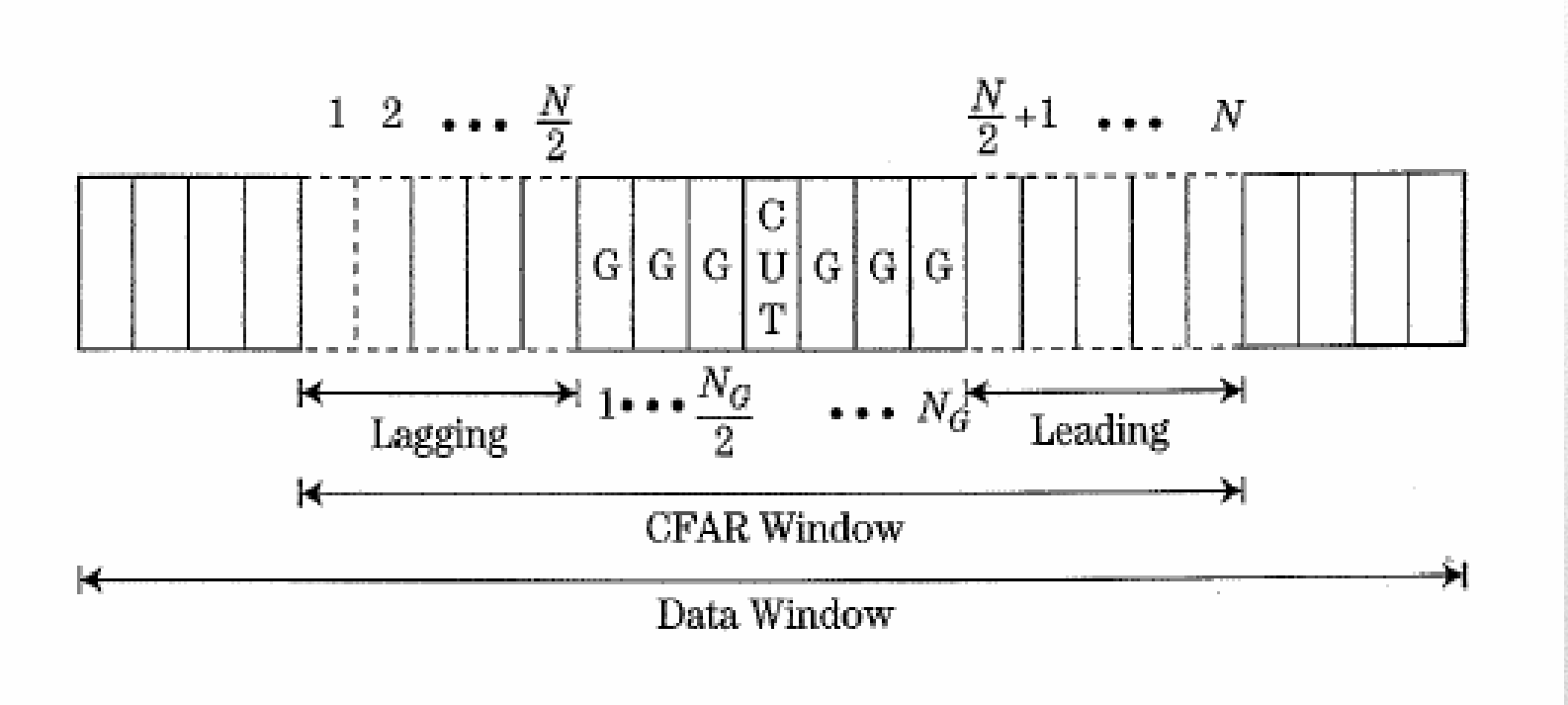
Schema generico di un'architettura CFAR monodim.



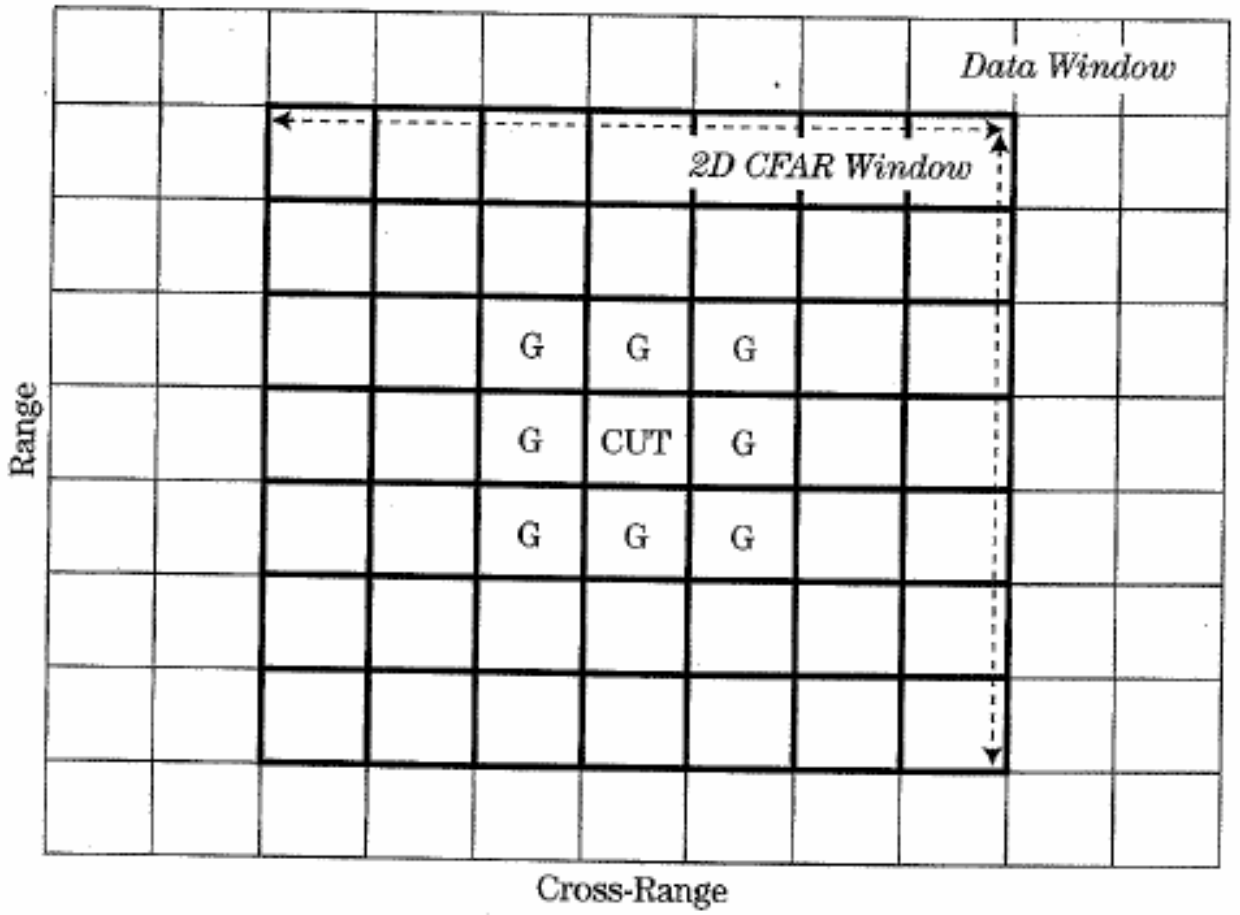
- Dopo il quadratore (Rectifier) i campioni vengono memorizzati in uno shift-register
- I campioni precedenti e seguenti la cella sotto test (CFAR window) vengono utilizzati per calcolare la soglia

Dettaglio della finestra CFAR



- N_G celle di guardia (G)
- N celle utilizzate per stimare la soglia di cui in genere N/2 precedenti e N/2 seguenti la cella sotto test (CUT)

Finestra CFAR bidimensionale



CA, GO, SO, OS-CFAR

La soglia nei CFAR incoerenti per rumore Gaussiano ha sempre questa forma:

$$T = \alpha\left(P_{FA}^{*}\right) g\left(\mathbf{z}\right)$$

dove

$$g_{CA}\left(\mathbf{z}\right) = \frac{1}{N}\sum_{n=1}^{N} z\left(n\right)$$

$$g_{GO}\left(\mathbf{z}\right) = \max\left(\frac{2}{N}\sum_{n=1}^{N/2} z\left(n\right), \frac{2}{N}\sum_{n=N/2+1}^{N} z\left(n\right)\right)$$

$$g_{SO}\left(\mathbf{z}\right) = \min\left(\frac{2}{N}\sum_{n=1}^{N/2} z\left(n\right), \frac{2}{N}\sum_{n=N/2+1}^{N} z\left(n\right)\right)$$

$$g_{OS}\left(\mathbf{z}\right) = z_K \quad z_1 < z_2 < \ldots < z_N$$

Espressioni della PFA

Incorporando il termine 1/N nel coefficiente CFAR della soglia di ottiene

$$\beta = \alpha / N$$

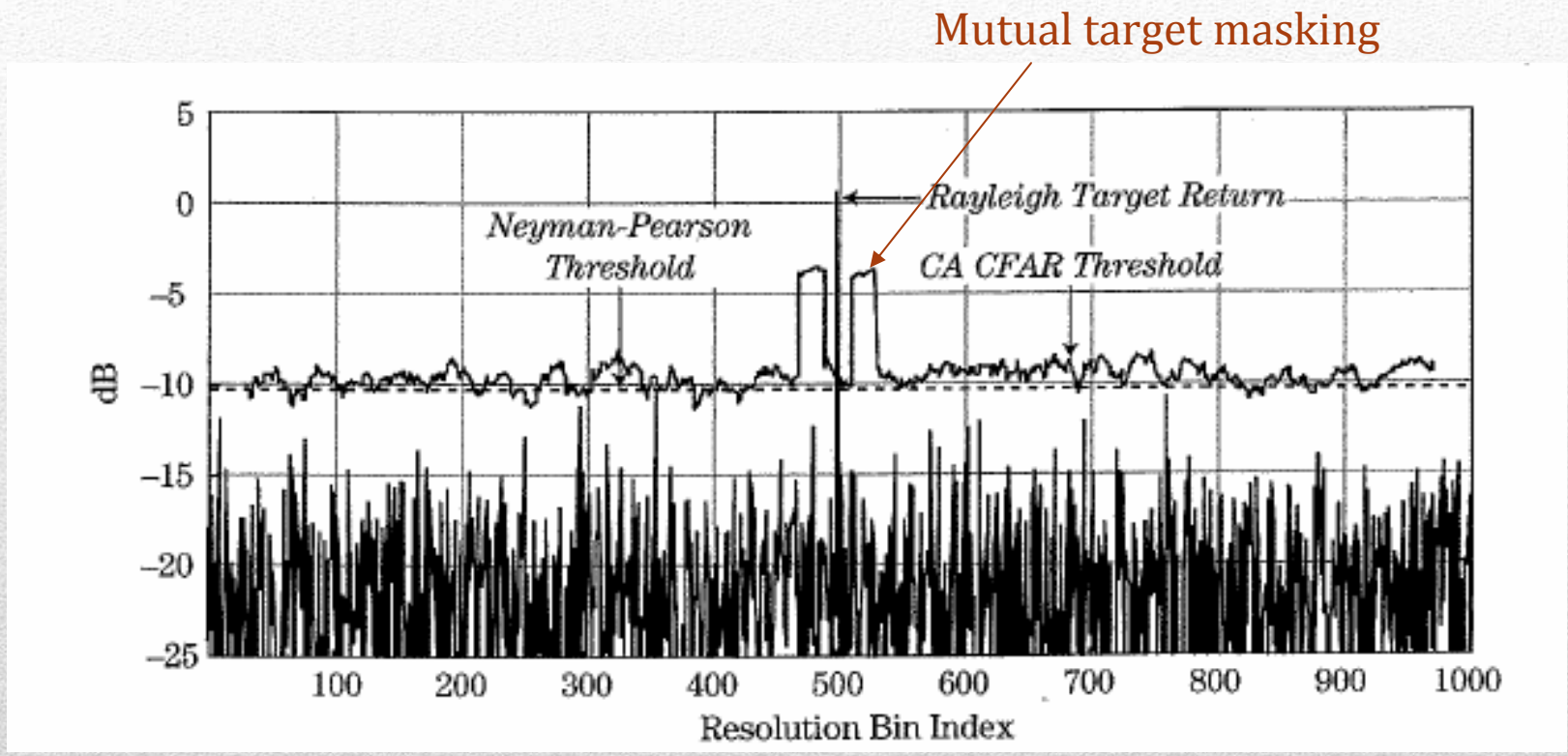
$$P_{FA-CA} = (1-\beta)^{-N}$$

$$P_{FA-GO} = 2(1+\beta)^{-N/2} - 2\sum_{k=0}^{N/2-1}\binom{N/2+k-1}{k}(2+\beta)^{-(N/2+k)}$$

$$P_{FA-SO} = 2(1+\beta)^{-N/2}\sum_{k=0}^{N/2-1}\binom{N/2+k-1}{k}(2+\beta)^{-k}$$

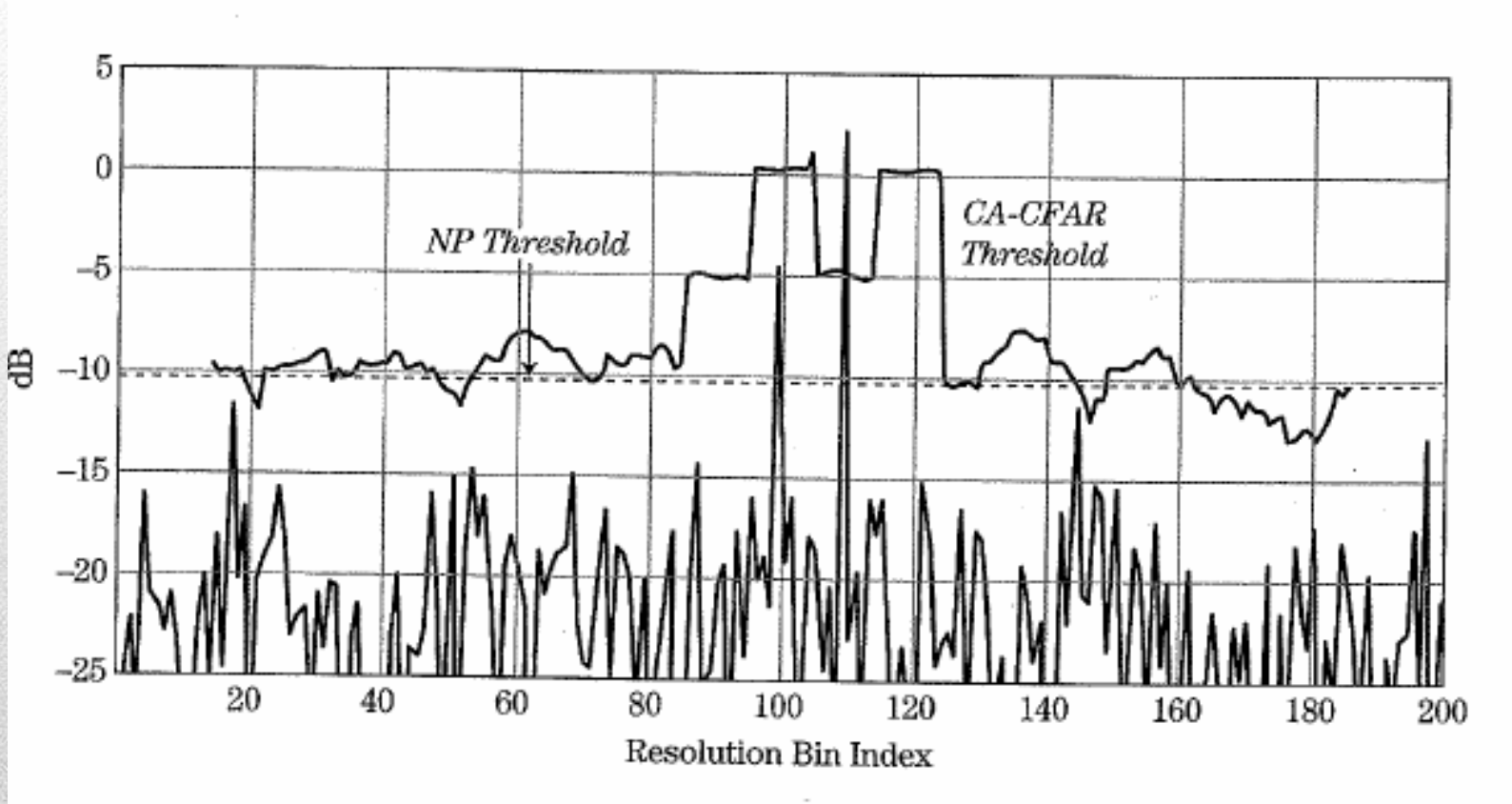
$$P_{FA-OS} = K\binom{N}{K}\frac{(K-1)!(\alpha+N-K)!}{(K+\alpha)!}$$

Esempio di soglia del CA-CFAR



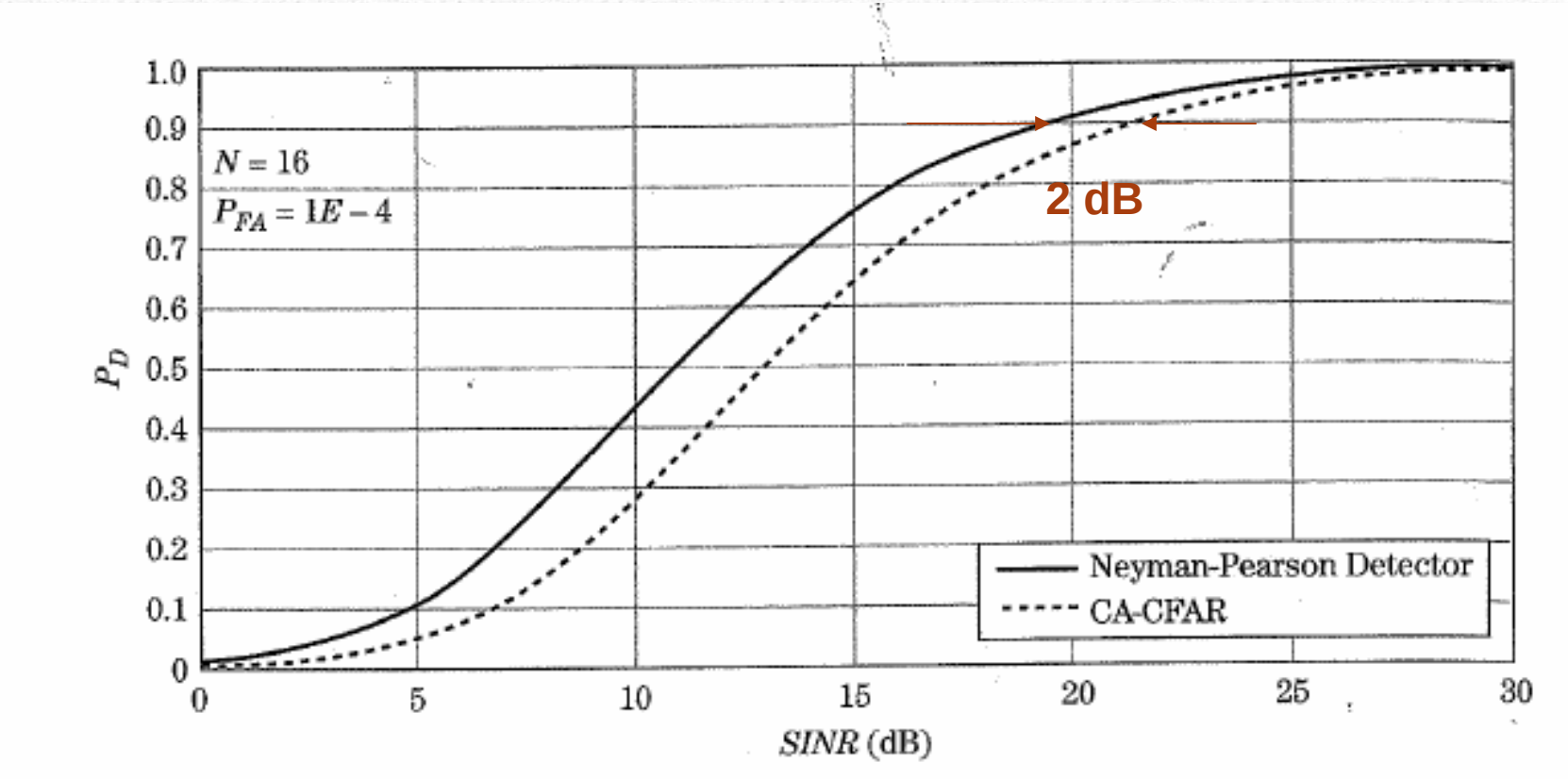
N=40, N_G=20, PFA=10^{-4}, target SW1 nella cella 500, SNR=20 dB

Mutual target masking



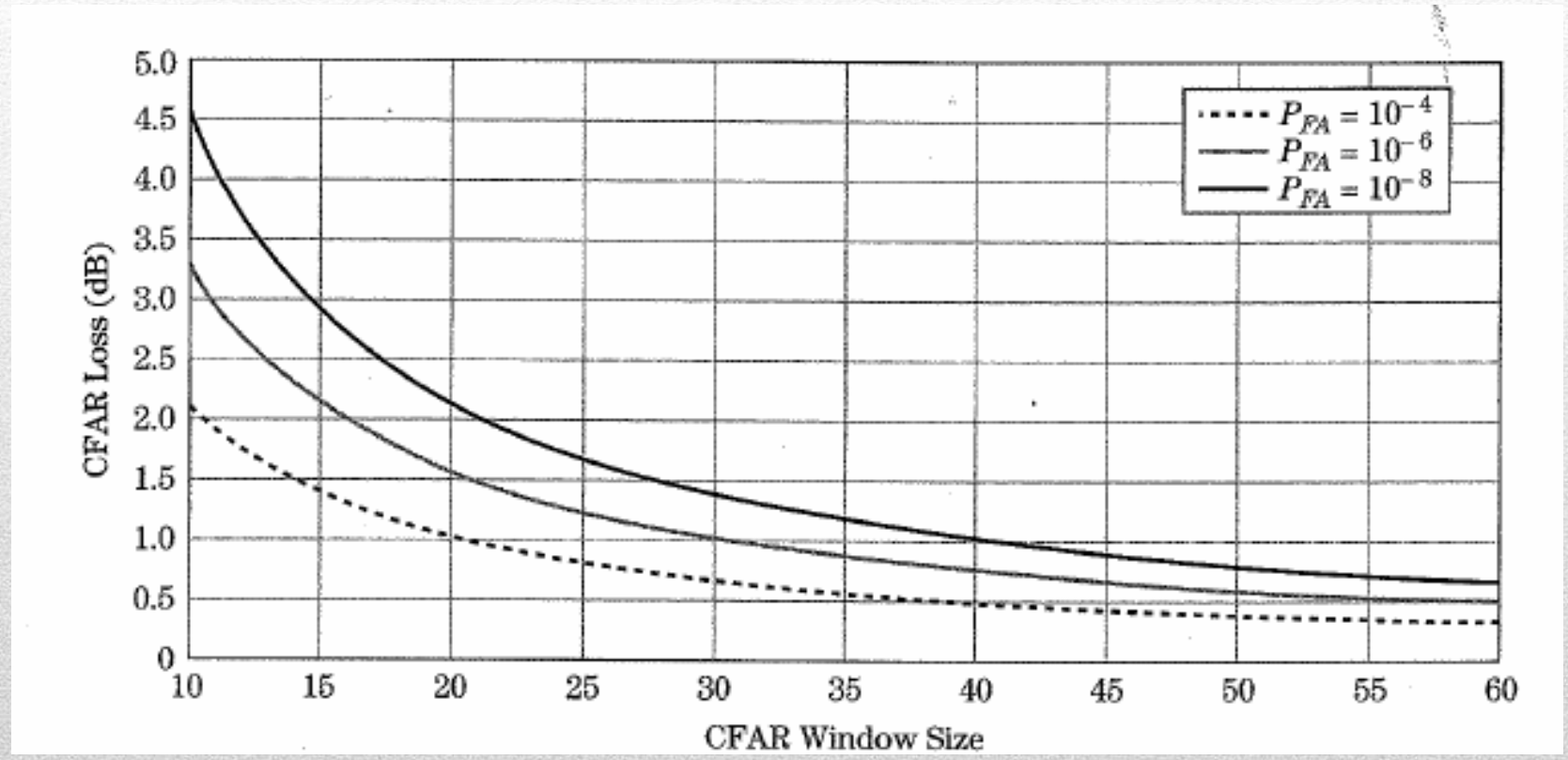
N=20, N_G=16, PFA=10^{-4}, SNR=20 dB

ROC del CA-CFAR e CFAR-loss



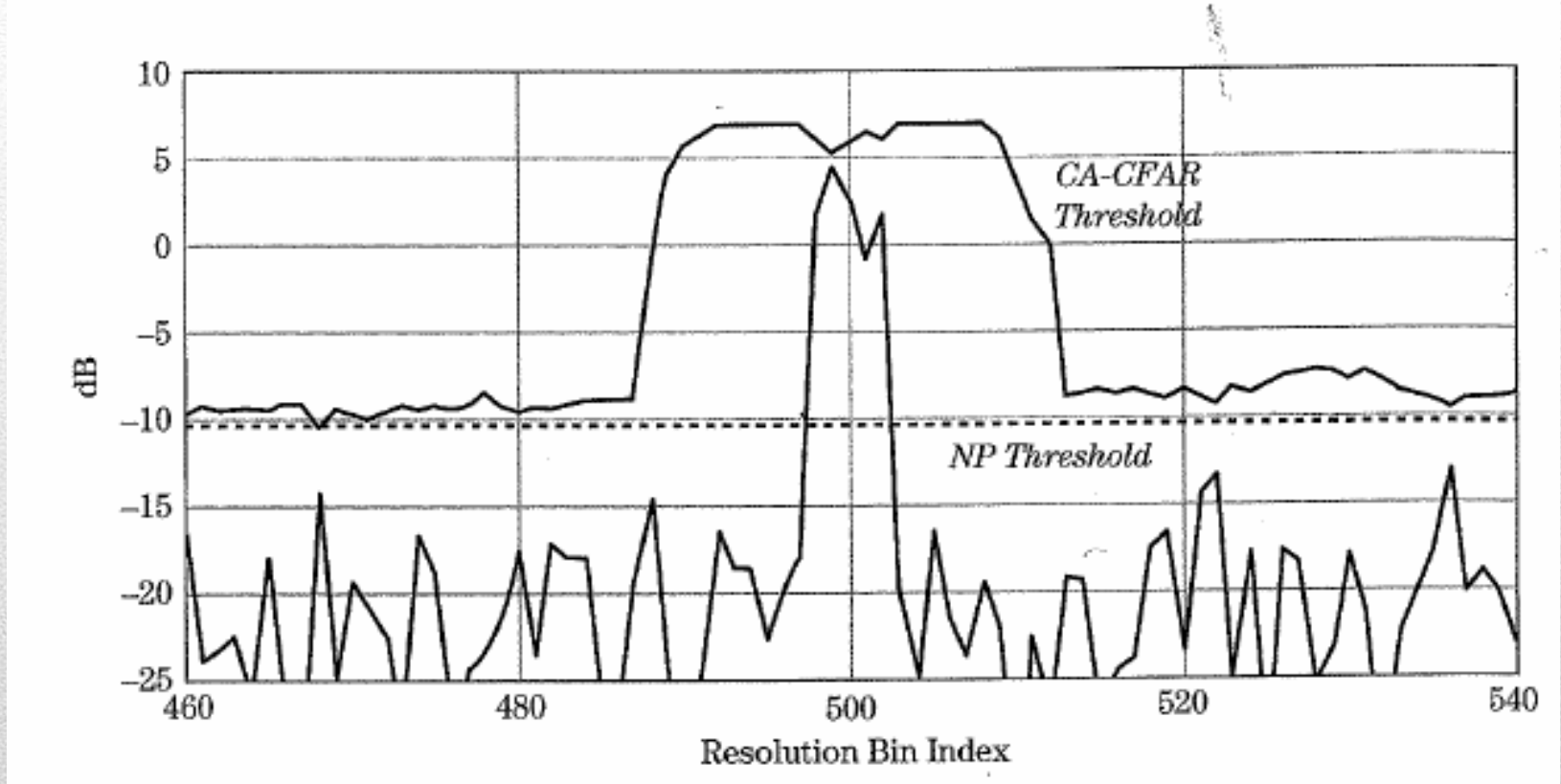
CFAR-loss $$L_{CFAR} = \frac{SNR_{CFAR}}{SNR_{NP}}$$

ROC del CA-CFAR e CFAR-loss



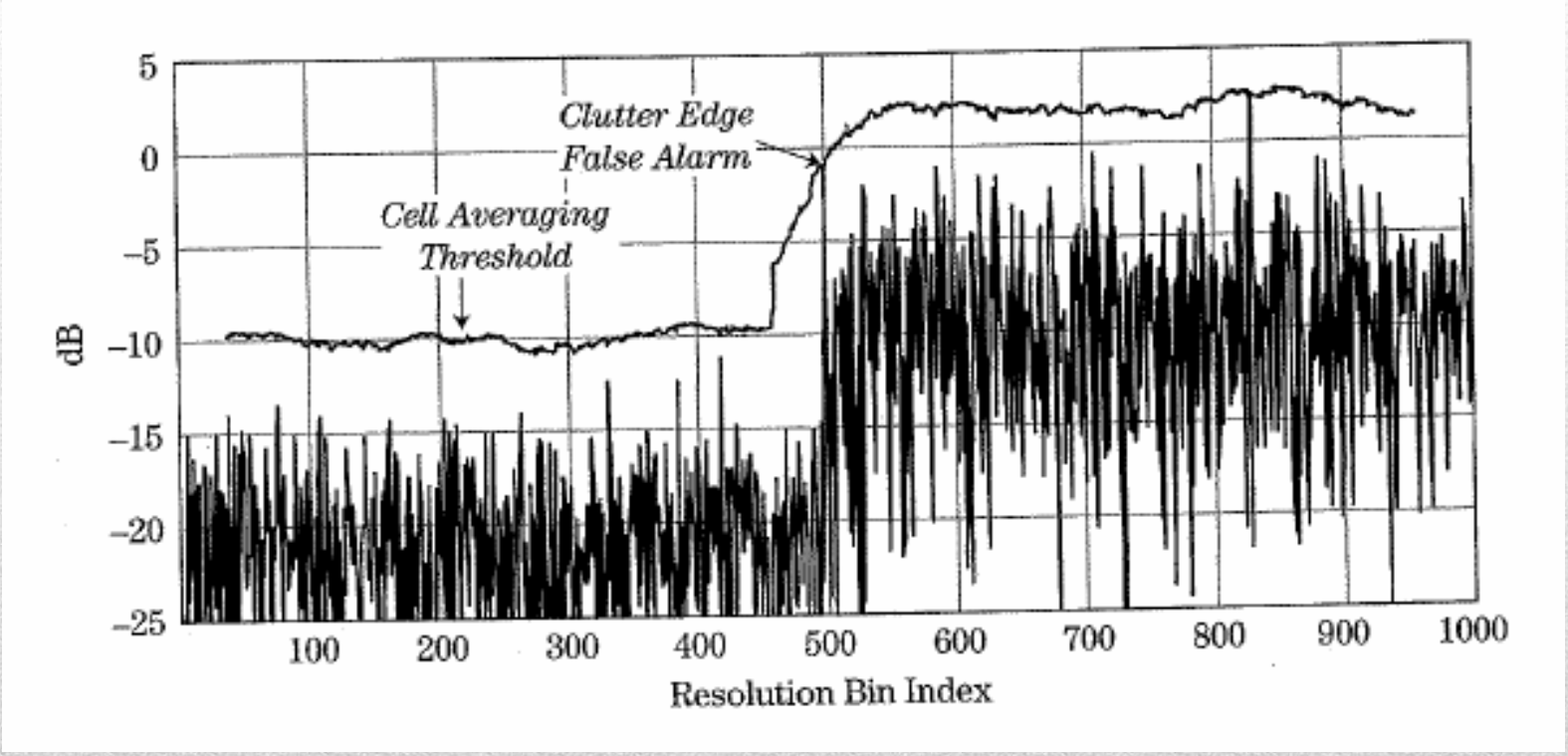
Le perdite CFAR diminuiscono all'aumentare di N

Target esteso e CA-CFAR



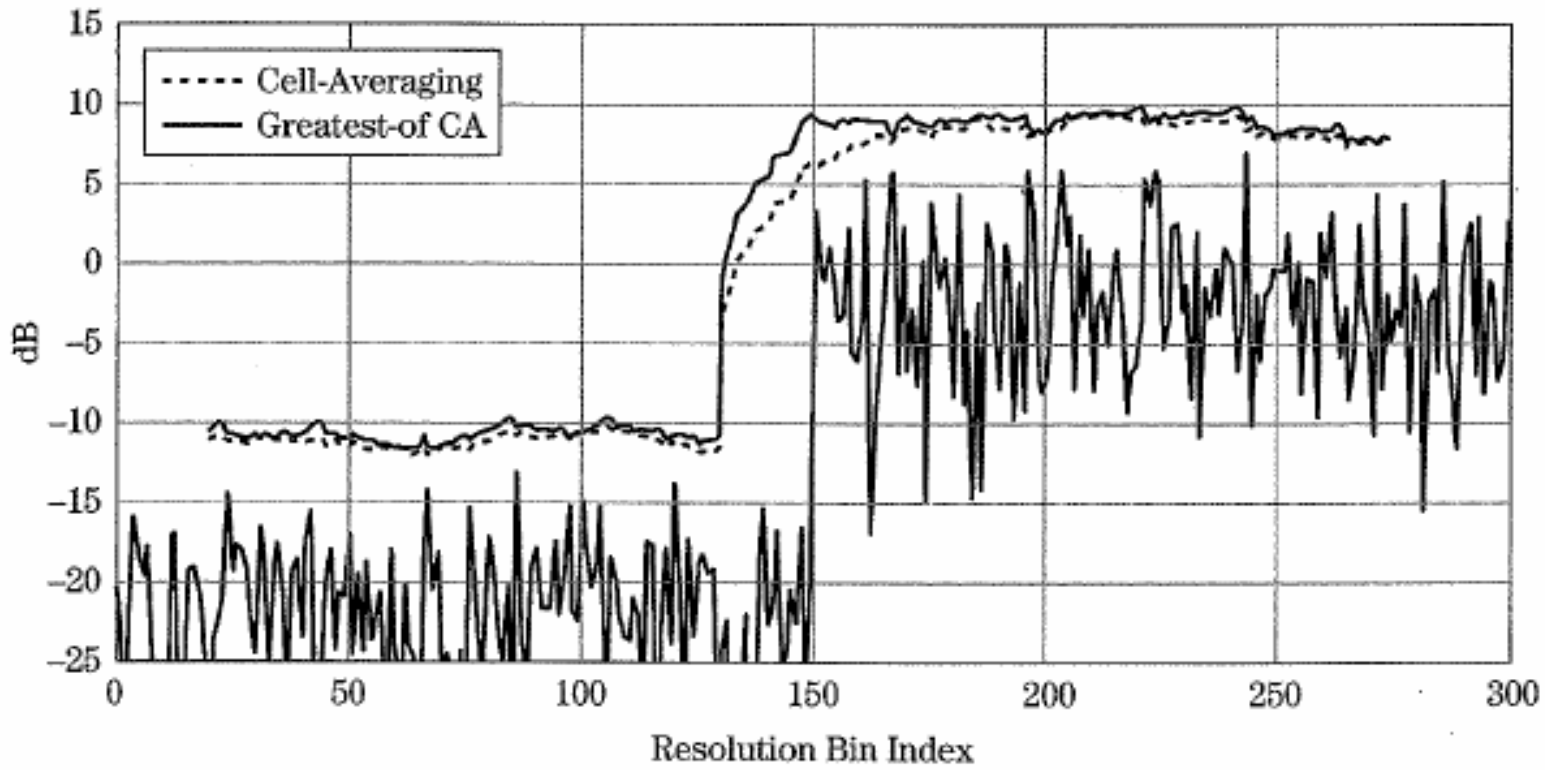
N=20, target esteso senza celle di guardia. Il target occupa 5 celle.
Si vede chiaramente l'automascheramento

Clutter edge



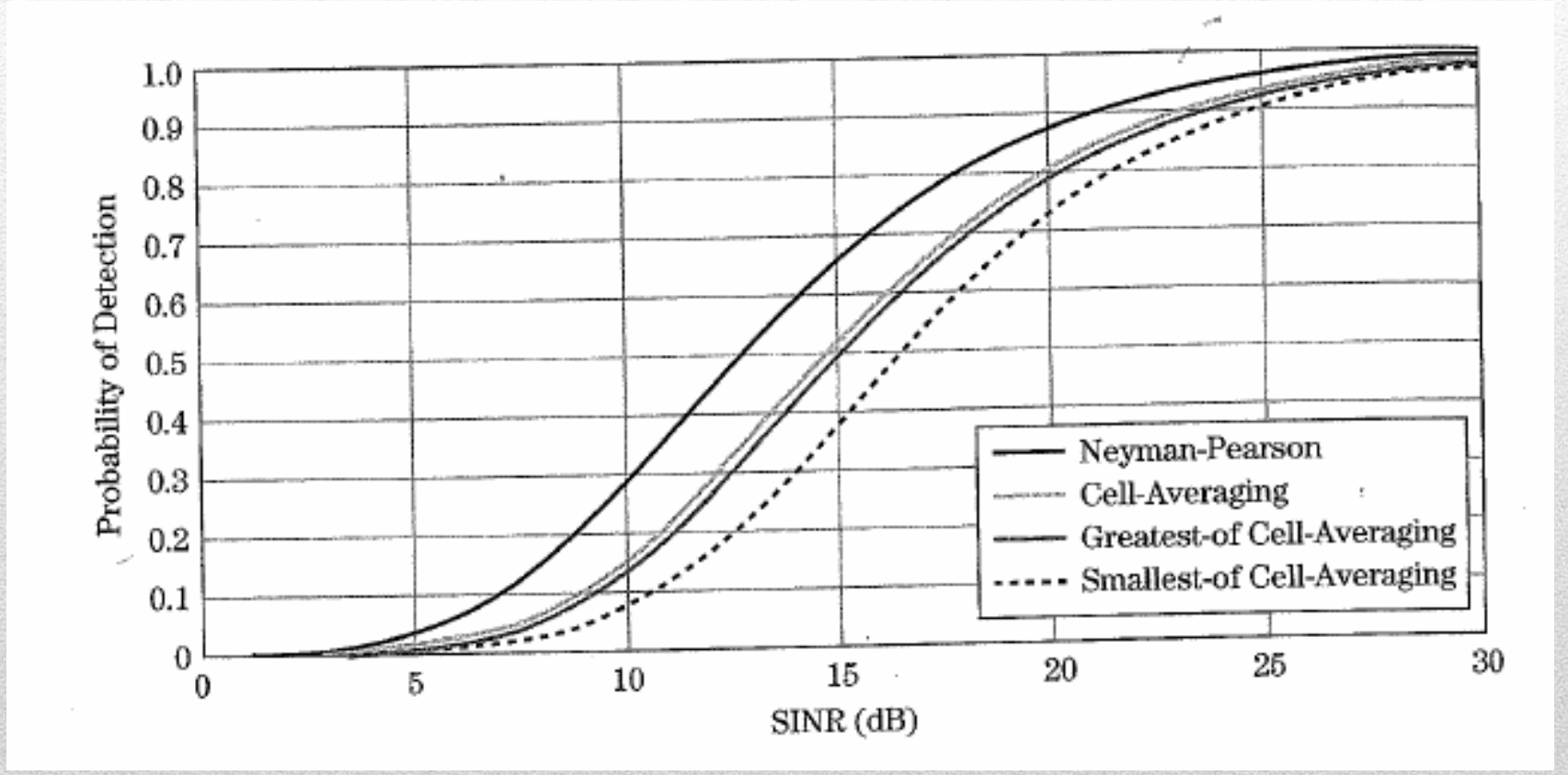
Nel CA-CFAR si generano dei falsi allarmi in presenza di clutter edge

Clutter edge e GO-CFAR

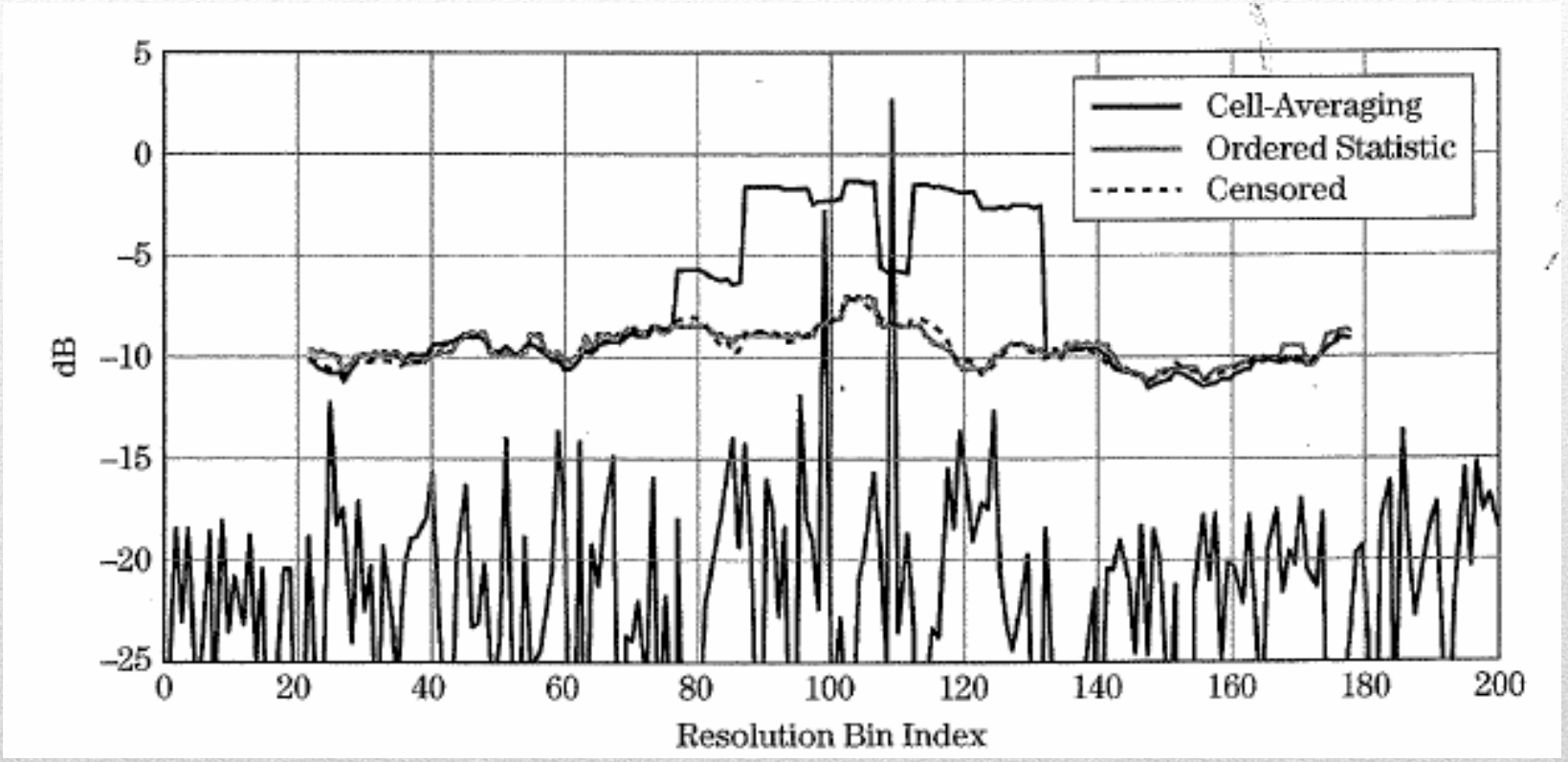


La soglia più alta del GO-CFAR riduce i falsi allarmi in presenza di clutter edge

Prestazioni dei vari CFAR in presenza di clutter Gaussiano omogeneo



OS-CFAR e target multipli



L'OS-CFAR mitiga l'effetto del mutuo mascheramento tra target