

List of Errata to Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency

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This documents lists typos detected in the published manuscript of:

Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends® in Signal Processing: Vol. 11: No. 3-4, pp 154-655. <http://dx.doi.org/10.1561/20000000093>

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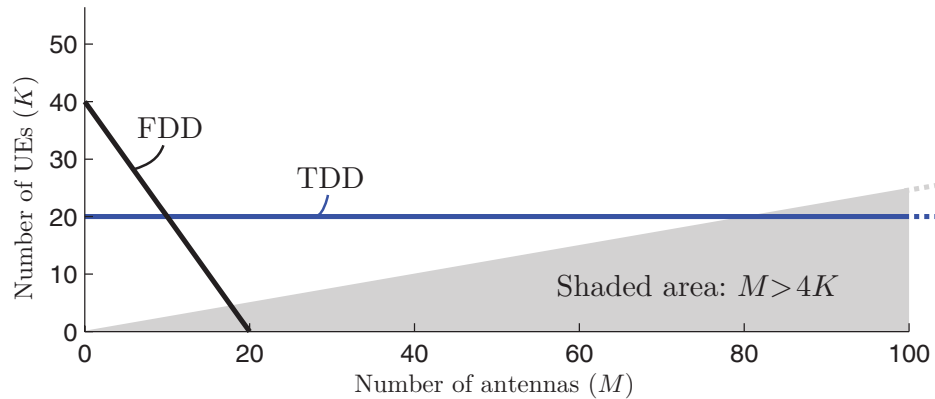
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If you discover a potential typo that is not listed in the latest version of this document, we appreciate if you report it to us. You can send an email to emil.bjornson@liu.se

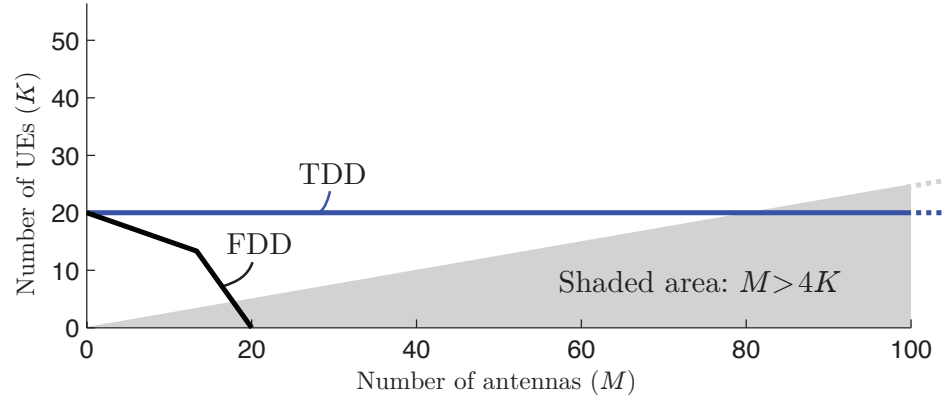
List of Errata

1. In the paragraph before Eq. (1.23), “horizontal ULA with antenna spacing d_H ” should be “horizontal ULA with antenna spacing $d_H \in (0, 0.5]$ ”.
2. In Section 1.3.5, the statement “the same as that of sending M additional UL pilot signals” is only true if $M \geq K$. To make it more accurate, the statement should instead be “the same as that of sending $\max(M, K)$ additional UL pilot signals” and the following sentence should be added to the footnote on the same page: “More precisely, with the multiplexing gain $\min(M, K)$ of SDMA, we need $\max(M, K)$ symbol transmissions to feed back the MK channel coefficients.”

Consequently, the average pilot overhead of the FDD protocol is $\frac{M+K+\max(M,K)}{2}$ and not $M + \frac{K}{2}$ (which is only correct for $M \geq K$). This error is found at several places in this section. Moreover, Figure 1.22 is shown as

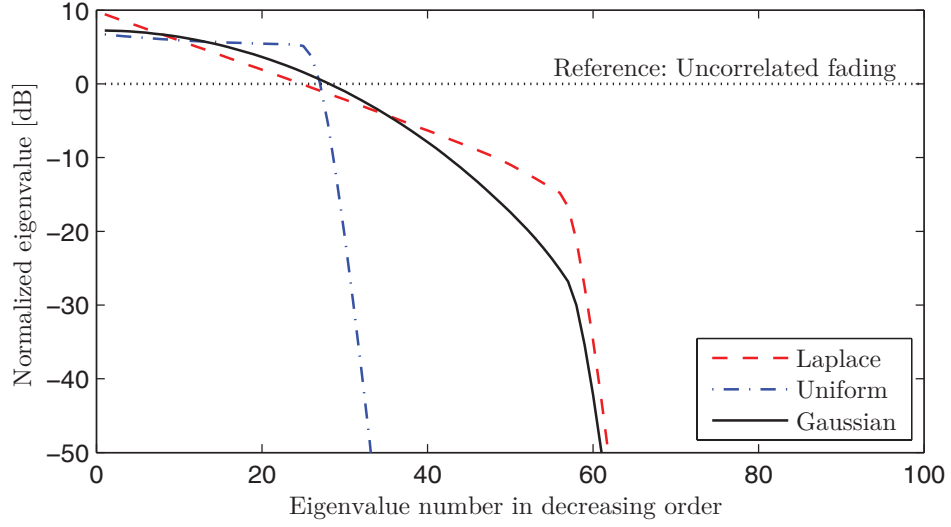


but should be

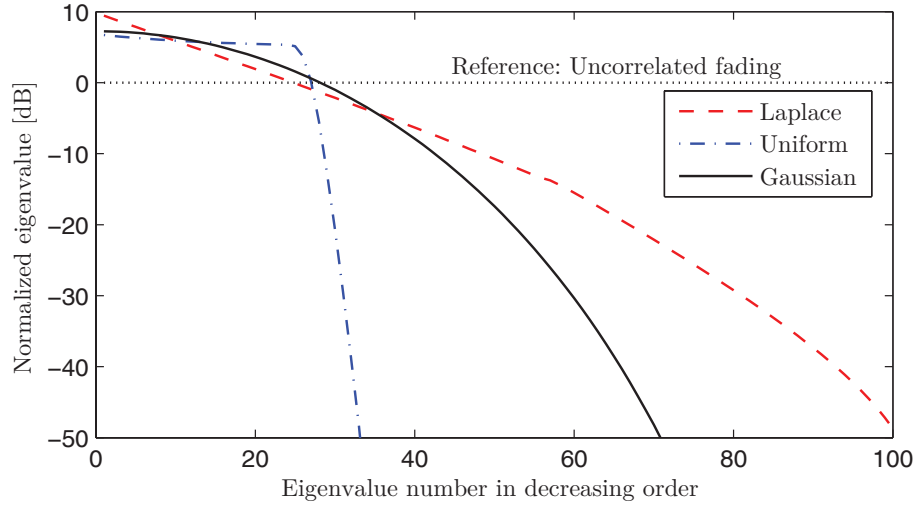


3. In Eq. (2.17), the final expression $\frac{\text{tr}((\mathbf{R}_{jk}^j)^2)}{(M_j \beta_{lk}^j)^2}$ should be $\frac{\text{tr}((\mathbf{R}_{jk}^j)^2)}{(M_j \beta_{jk}^j)^2}$.

4. Figure 2.6 is shown as



but should be



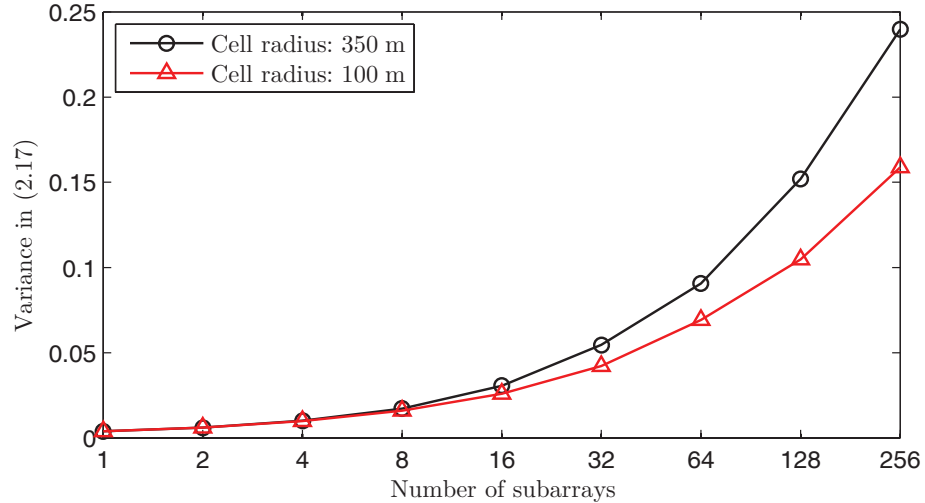
This error was a consequence of insufficient accuracy in the computation of the covariance matrices. The related sentence

“In fact, a uniform angular distribution makes 66% of the eigenvalues 50 dB smaller than in the reference case, while this happens for around 40% of the eigenvalues with Gaussian and Laplace distributions.”

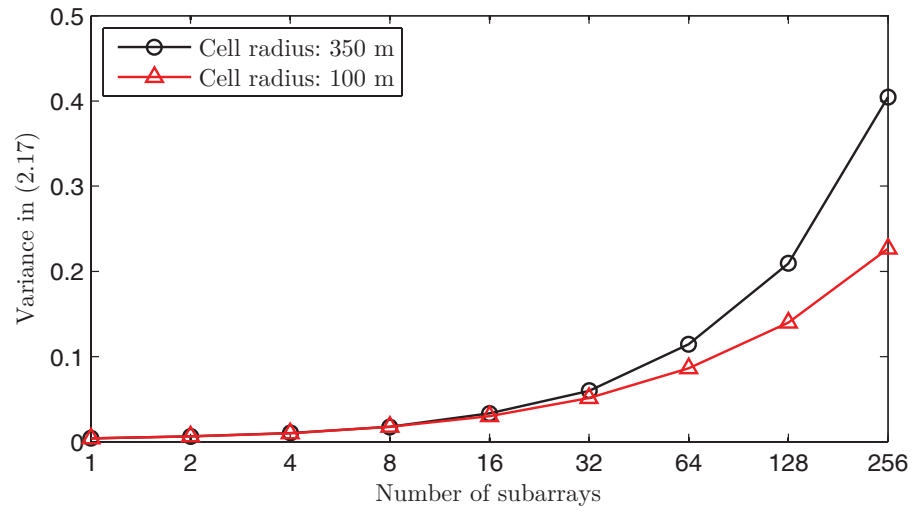
should read as

“In fact, a uniform angular distribution makes 68% of the eigenvalues 30 dB smaller than in the reference case, while this happens for 40% of the eigenvalues with Gaussian distribution and 19% with Laplace distribution.”

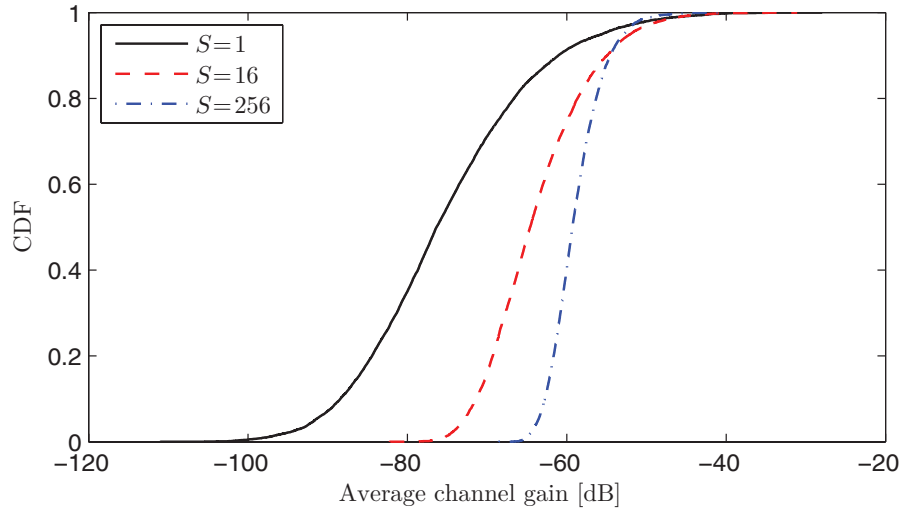
5. In the first paragraph of Section 3.3.3, $\mathbf{h}_{li}^j \sim \mathcal{N}_{\mathbb{C}}(\mathbf{0}_M, \mathbf{R}_{li}^j)$ should be $\mathbf{h}_{li}^j \sim \mathcal{N}_{\mathbb{C}}(\mathbf{0}_{M_j}, \mathbf{R}_{li}^j)$.
6. In Eq. (3.36), \mathbf{I}_M should be \mathbf{I}_{M_j} . This typo also appears on the row right above Eq. (3.37).
7. In Eq. (3.38), $\frac{1}{p_{li}} \left(\Psi_{li}^j \right)^{-1}$ should be $\frac{1}{p_{li} \tau_p} \left(\Psi_{li}^j \right)^{-1}$.
8. In the paragraph after Theorem 4.6, the statement “reduce the number of samples τ_d used for DL data” should be “reduce the number of samples τ_u used for UL data”.
9. In Eq. (4.29), σ_{UL}^2 should be σ_{DL}^2 .
10. In Section 5.3, the statement “The efficiency of a PA is defined as the ratio of input power to output power” should be “The efficiency of a PA is defined as the ratio of output power to input power”.
11. In Section 6.1.2, after Eq. (6.7), the statement “LTE only requires $\text{EVM} \leq 0.0175$ ” should be “LTE only requires $\text{EVM} \leq 0.175$ ”
12. The subsection title “7.4.1 Physical Array Size and Antenna Spacing” should be “7.4.1 Preliminaries on Physical Array Size”.
13. Figure 7.26 is shown as



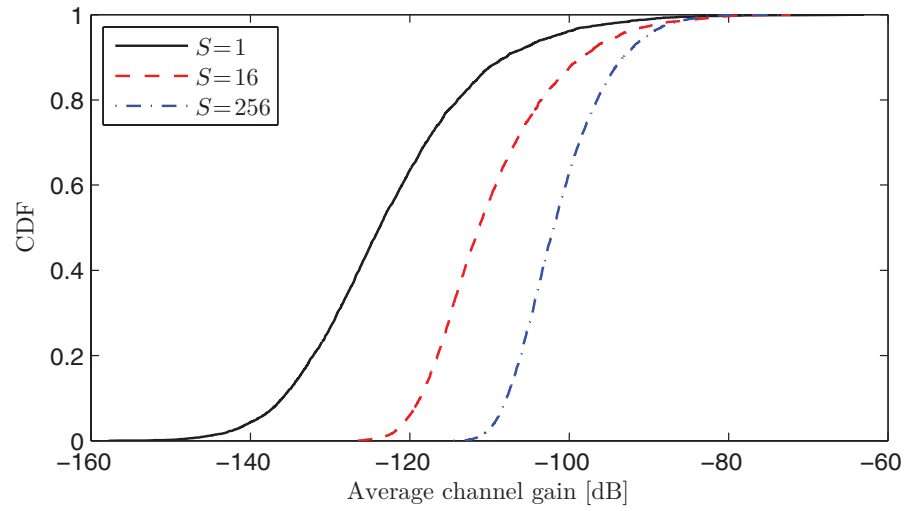
but should be



14. Figure 7.27 is shown as



but should be



In the paragraph that describes this figure, the sentence “However, going from $S = 1$ to $S = 16$ improves the median of β by around 9 dB; increasing this number to $S = 256$ adds another 5 dB.” should read as: “However, going from $S = 1$ to $S = 16$ improves the median of β by around 12.5 dB; increasing this number to $S = 256$ adds another 9.5 dB.”

15. The second paragraph of Definition B.8 should read as follows:

“If the random variable x , with support in \mathcal{X} and PDF $f(x)$, is given and the conditional PDF is $f(y|x)$, then the conditional differential entropy is

$$\mathcal{H}(y|x) = - \int_{\mathcal{Y}} \int_{\mathcal{X}} \log_2 (f(y|x)) f(y|x) f(x) dx dy.” \quad (\text{B.57})$$

16. In the paragraph after (C.63), $\mathbf{A} = \tau_p \mathbf{\Psi}_{jk}^j$ should be $\mathbf{A} = \tau_p (\mathbf{\Psi}_{jk}^j)^{-1}$.