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Bibliografia

- [1] FOSCHINI, G. J.; GANS, M. J. *On Limits of Wireless Communication in a Fading Environment when Using Multiple Antennas*. Wireless Pers. Commum., Vol. 6, pp. 311-335, Mar. 1998.
- [2] FOSCHINI, G. J. *Layered Space-time Architecture for Wireless Communications in a Fading Environment when using Multielement Antennas*. Bell Labs Tech. J., pp. 41-59, August 1996.
- [3] TELETAR, E. *Capacity of Multiantenna Gaussian Channels*. AT&T Bell Labs, Tech. Memo., June 1995.
- [4] BOLCSKEI, H.; GESBERT, D.; J. PAULRAJ, A. *On the Capacity of OFDM based Spatial Multiplexing Systems*. IEEE Trans. Commum., Vol. 50, pp. 225-234, Feb. 2002.
- [5] GOLDEN, G. D.; FOSCHINI, G. J.; VALENZUELA, R. A.; WOLNIANSKY, P. W. *Detection Algorithm and Initial Laboratory Results using the V-BLAST Space-time Communication Architecture*. Electron. Lett., Vol. 35, n. 1, pp. 14-15, 1999.
- [6] SILVERSTEIN, J. W. *Strong Convergence of Empirical Distribution of Eigenvalues of Large Dimensional Random Matrices*. J. Multivariate Anal., Vol. 55, n. 2, pp. 331-339, 1995.
- [7] DRIESSEN, P. F.; FOSCHINI, G. J. *On the Capacity Formula for Multiple-Input Multiple-Output Channel: A Geometric Interpretation*. IEEE Trans. Commum., Vol. 47, pp. 173-176, Feb. 1999.

- [8] KYRITSIS, P. ***Multiples Antenna Systems in an Indoor Environment***, dissertation submitted to the Department of Electrical Engineering and the Committee on Graduated Studies of Stanford University, November 2001.
- [9] KYRITSIS, P.; COX, D. C.; VALENZUELA, R. A.; WOLNIANSKY, P. W. ***Correlation Analysis Based on MIMO Channel Measurements in an Indoor Environment***. IEEE J. Select. Areas Commun. Series, Vol. 21, n. 5, June 2003, pp. 713-720.
- [10] SHIU, D.; FOSCHINI, G. J.; GANS, M. J.; KAHM, J. M. ***Fading correlation and its effect on the capacity of multi-antenna systems***. IEEE Trans. Commun., Vol. 48, pp. 502-513, Mar. 2000.
- [11] GESBERT, D.; BOLCSKEI, H.; GORE, A. D.; PAULRAJ, A. J. ***Outdoor MIMO Wireless Channels: Models and Performance Prediction***. IEEE Transaction on Communications, Vol. 50, n. 12, pp. 1926-1934, Dec. 2002.
- [12] CHIZHIK, D.; FOSCHINI, G. J.; VALENZUELA, R. A. ***Capacities of Multi-Element Transmitti and Receive Antennas: Correlations and Keyholes***. Electronic Letters, Vol. 36, n. 13, pp. 1099-1100, Jun. 2000.
- [13] YU, K.; OTTERSTEN, B. ***Models for MIMO Propagation Channels, a Review***. Special Issue on Adaptive Antennas and MIMO Systems. Wiley Journal on Wireless Communications and Mobile Computing, 2002.
- [14] KERMOAL, J. P.; SCHUMACHER, L.; MOGENSEN, P. E.; PEDERSEN, K. I. ***Experimental Investigation of Correlation Properties of MIMO Radio Channels for Indoor Picocell Scenarios***. In Proceedings of IEEE Vehicular Technology Conference (IEEE VTC Fall), Vol. 1, pp. 14-21, 2000.
- [15] KERMOAL, J. P.; SCHUMACHER, L.; PEDERSEN, K. I.; MOGENSEN, P. E.; FREDERIKSEN, F. ***A Stochastic MIMO Radio Channel Model with Experimental Validation***. IEEE Journal on Selected Areas in Communications, 20(6):1211-1226, August 2002.

- [16] PEDERSEN, K. I.; ANDERSEN, J. B.; KERMOAL, J. P.; MOGENSEN, P. ***A Stochastic Multiple-Input-Multiple-Output Radio Channel Model for Evaluation of Space-time Coding Algorithms.*** In Proceedings IEEE Vehicular Technology Conference. Vol. 2, pp. 893-897. Fall, 2000.
- [17] MCNAMARA, D. P.; BEACH, M. A.; FLETCHER, P. N.; KARLSSON, D. P. ***Initial Investigation of Multiple-Input Multiple-Output Channels in Indoor Environments.*** In Proceedings IEEE Benelux Chapter Symposium on Communications and Vehicular Technology, Leuven, Belgium, pp. 139-143, October 2000.
- [18] YU, K.; BENGTTSSON, M.; OTTERSTEN, B.; KARLSSON, P.; MCNAMARA D.; BEACH, D. M. ***Measurement Analysis of NLOS Indoor MIMO Channels.*** In Proceedings of IST Mobile Communications Summit. pp. 277-282, September 2001.
- [19] YU, K.; BENGTTSSON, M.; OTTERSTEN, B.; MCNAMARA, D.; KARLSSON, P.; BEACH, M. ***Second Order Statistics of NLOS Indoor MIMO Channels based on 5.2 GHz Measurements.*** In Proceedings of IEEE Global Telecommunications Conference, Vol. 1, pp. 156-160, November 2001.
- [20] YU, K.; BENGTTSSON, M.; OTTERSTEN, B.; BEACH, M. ***Narrowband MIMO Channel Modeling for LOS Indoor Scenarios.*** In Proceedings XXVIIth Triennial General Assembly of the International Union of Radio Science (URSI), August 2002. Invited Paper.
- [21] CHUAH, C-N.; TSE, D. N. C.; KAHN, J. M.; VALENZUELA, R. A. ***Capacity Scaling in MIMO Wireless Systems under Correlated Fading.*** IEEE Transaction on Information Theory, 48(3):637-650, March 2002.
- [22] LUCENT; NOKIA; SIEMENS; ERICSSON. ***A Standardized Set of MIMO Radio Propagation Channels.*** 3GPP, TSG RAN WG1, R1-01-1179, Jeju, Korea, November 2001.
- [23] YU, K.; BENGTTSSON, M.; OTTERSTEN, B.; MCNAMARA, D.; KARLSSON, P.; BEACH, M. ***A Wideband Statistical Model for NLOS Indoor MIMO Channels.*** In Proceedings IEEE Vehicular Technology Conference, Vol. 1, pp. 370-374. IEEE VTC Spring, 2002.

- [24] WALLACE, J. W.; JENSEN, M. A. ***Modeling the Indoor MIMO Wireless Channel***. IEEE Transactions on Antennas and Propagation, 50(5):591-599, May 2002.
- [25] SALEH, A.; VALENZUELA, R. ***A Statistical Model for Indoor multipath Propagation***. IEEE Journal on Selected Areas in Communications, SAC-5(2):128-137, February 1987.
- [26] CORREIA, L. M. ***Wireless Flexible Personalised Communications***. Chapter 3, pp. 77-277. John Wiley & Sons, 2001.
- [27] MOLISCH, A. F. ***A Generic Model for MIMO Wireless Propagation Channels***. In Proceedings IEEE International Conference on Communications, Vol. 1, pp. 277-282, 2002.
- [28] FUHL, J.; MOLISCH, A. F.; BONECK, E. ***Unified Channel Model for Mobile Radio Systems with Smart Antennas***, In Proceedings IEEE Radar, Sonar and Navigation, Vol. 145, n. 1, pp. 32-41, 1998.
- [29] MARTIN, C. C.; WINTERS, J. H.; SOLLENBERGER, N. R. ***Multiple-Input Multiple-Output (MIMO) Radio Channel Measurements***, IEEE Vehicular Technology Conference, Vol. 2, pp. 774-779. IEEE VTC Fall, 2000.
- [30] OZCELIK, H.; HERDIN, M.; HOFSTETTER, H.; BONEK, E. ***A Comparison of Measured 8x8 MIMO Systems with a Popular Stochastic Channel Model at 5.2 GHz***, ICT 2003, Vol. 2, pp. 1542-1546, Feb23-Mar1 2003.
- [31] OZCELIK, H.; HERDIN, M.; WEICHSELBERGER, W.; WALLACE, J.; BONEK, E. ***Deficiencies of Kronecker MIMO Radio Channel Model***, Electronics Letters, Vol. 39, Issue 16, pp. 1209-1210, 7 August 2003.
- [32] GANS, M. J.; AMITAY, N.; YEH, Y. S.; HAO XU; DAMEN, T. C.; VALENZUELA, R. A.; SIZER, T.; STORZ, R.; TAYLOR, D.; MACDONALD, W. M.; TRAN CUONG; ADAMIECKI, A. ***Outdoor Blast Measurements Systems at 2.44 GHz Calibration and Initial Results***. IEEE Journal on Selected Areas in Communications, Vol. 20, Issue 3, pp. 570-583, April 2002.

- [33] HOWARD, S.; INANOGLU, H.; KETCHUM, J.; WALLACE, M.; WALTON, R. **Results from MIMO Channel Measurements**, The 13th IEEE International Symposium on Personal Indoor and Mobile Radio Communications, Vol. 4, pp. 1932-1936, 15-18 Sept. 2002.
- [34] CHIZHIK, D.; LING, J.; WOLNIANSKY, P. W.; VALENZUELA, R. A.; COSTA, N.; HUBER, K. **Multiple Input Multiple Output Measurements and Modeling in Manhattan** IEEE Journal on Selected Areas in Communications, Vol. 21, Issue 3, pp. 321-331, April 2003.
- [35] MOLISCH, A. F.; STEINBAUER, M.; TOELTSCH, M.; BONEK, E.; THOMA, R. S. **Capacity of MIMO Systems based on measured Wireless Channels**. IEEE Journal on Selected Areas in Communications, Vol. 20, pp. 561-569, April 2002.
- [36] KERMOAL, J. P.; MOGENSEN, P. E.; JENSEN, S. H.; ANDERSEN, J. B.; FREDERIKSEN, F.; SORENSEN, T. B.; PEDERSEN, K. I. **Experimental Investigation of Multipath Richness for Multi-element Transmit and Receive Antenna Array**. VTC 2000-Spring Tokyo. IEEE 51st, Vol. 3, pp. 2004-2008, 15-18 May 2000.
- [37] ABDI, A.; KAVEH, M. **A Space-time Correlation Model for Multielement Antenna Systems in Mobile Fading Channels**. IEEE Journal on Selected Areas in Communications, 20(3):550-560, April 2002.
- [38] ABDI, A.; BARGER, J. A.; KAVEH, M. **A Parametric Model for the Distribution of Angle of Arrival and the Associated Correlation Function and Power Spectrum**. IEEE Trans. Veh. Technol. To be published.
- [39] DERRYBERRY, R. T.; GRAY, S. D.; IONESCU, D. M.; G. MANDYAM; B. RAGHOTHAMAN, **Transmit Diversity em 3G CDMA Systems**. IEEE Communications Magazine, pp. 68-75, April 2002.
- [40] SESHADRI, N.; WINTERS J. H. **Two Schemes for Improving the Performance of Frequency-division Duplex (FDD) Transmission Systems using Transmitter Antenna Diversity**. Int. J. Wireless Information Networks, Vol. 1, pp. 49-60, Jan. 1994.

- [41] TAROKH,V.; SESHADRI, N.; CALDERBANK, A. R. ***Space-time Codes for High Data Rate Wireless Communication: Performance Criterion and Code Construction.*** IEEE Trans. Inform. Theory, Vol. 44, pp. 744-765, Mar. 1998.
- [42] NAGUIB, A.; SESHADRI, N.; CALDERBANK, A. R. ***Increasing Data Rate over Wireless Channel.*** IEEE Signal Processing Mag., Vol. 17, pp. 76-92, May. 2000.
- [43] ALAMOUTI, S. ***Space Block Coding: A Simple Transmitter Diversity Technique for Wireless Communications.*** IEEE J. Select. Areas. Commun., Vol. 16, pp. 1451-1458, Oct. 1998.
- [44] TAROKH, V.; JAFARKHANI, J.; CALDERBANK, A. R. ***Space-time Block Codes from Orthogonal Designs.*** IEEE Trans. Inform. Theory, Vol. 45, pp. 1456-1467, July 1999.
- [45] TAROKH, V.; JAFARKHANI, J.; CALDERBANK, A. R. ***Space-time Block Codes for Wireless Communications: Performance Results,*** IEEE J. Select. Areas. Commun. Vol. 17, pp. 451-460, Mar. 1999.
- [46] ZHENG, L.; CTSE, D. N. ***Diversity and Multiplexing: A Fundamental Tradeoff in Multiple Antenna Channels.*** IEEE Transactions on Information Theory, Vol. 49, Issue 5, pp. 1073-1096, May 2003.
- [47] GALLAGER, R. G. ***Information Theory and Reliable Communications.*** John Wiley and Sons, INC, 1968.
- [48] SKENTOS,N.; KANATAS, A. G.; PANTOS, G.; CONSTANTINOU, P. ***Capacity Results from Short Range Fixed MIMO Measurements at 5.2 GHz in Urban Propagation Environment.*** Communications, 2004 IEEE International Conference on Vol. 5, pp. 3020-3024, 20-24 June 2004.
- [49] PAL, A.; CHOR MIN TAN; BEACH, M. A. ***Comparison of MIMO Channels from Multipath Parameter Extraction and Direct Channel Measurements.*** Personal, Indoor and Mobile Radio Communications, 2004. PIMRC 2004. 15th IEEE International Symposium on Vol. 3, pp. 1574-1578, 5-8 Sept. 2004.

- [50] STEINBAUER, M.; MOLISCH, A. F.; BONEK, E. ***The Double-directional Radio Channel***. Antennas and Propagation Magazine, IEEE Vol. 43, Issue 4, pp. 51-63, Aug. 2001.
- [51] RAPPAPORT, T. S. ***Wireless Communications Principles and Practices***. New Jersey, Prentice-Hall Communication Engineering and Emerging Technologies Series, 1996.
- [52] SWINDLEHURST, A. L.; GERMAN, G.; WALLACE, J.; JENSEN, M. ***Experimental Measurements of Capacity for MIMO Indoor Wireless Channels***. Wireless Communications 2001. (SPAWC '01). IEEE Third Workshop on Signal Processing Advances, pp. 30-33, 20-23 March 2001.
- [53] DANDEKAR, K. R.; ARREDONDO, A.; XU GUANGHAN; HAO LING. ***Using Ray Tracing to Study Urban Vector Channel Propagation Characteristics***. Vehicular Technology Conference, IEEE 49th, Vol. 1, pp. 381-385, 16-20 May 1999.
- [54] OESTGES, C.; ERCEG, V.; JPAULRAJ, A. ***A Physical Scattering Model for MIMO Macrocellular Broadband Wireless Channels***. Selected Areas in Communications, IEEE Journal on Vol. 21, Issue 5, pp. 721-729, June 2003.
- [55] ZWICK, T.; FISCHER, C.; WIESBECK, W. ***A Stochastic Multipath Channel Model including Path Directions for Indoor Environments***. Selected Areas in Communications, IEEE Journal on Vol. 20, Issue 6, pp. 1178-1192, August 2002.
- [56] SPENCER, Q. H.; JEFFS, B. D.; JENSEN, M. A.; SWINDLEHURST, A. L. ***Modeling the Statistical Time and Angle of Arrival Characteristics of an Indoor Multipath Channel***. Selected Areas in Communications, IEEE Journal on Vol. 18, Issue 3, pp. 347-360, March 2000.
- [57] FUHL, J.; MOLISCH, A. F.; BONEK, E. ***Unified Channel Model for Mobile Radio Systems with Smart Antennas***. Radar, Sonar and Navigation, IEE Proceedings, Vol. 145, Issue 1, pp. 32-41, Feb. 1998.

- [58] GANESH, R.; PAHLAVAN, K. ***Statistical Modelling and Computer Simulation of Indoor Radio Channel***. Communications, Speech and Vision, IEE Proceedings I, Vol. 138, Issue 3, pp. 153-161, June 1991.
- [59] MOLISCH, A. F.; STEINBAUER, M.; TOELTSCH, M.; BONEK, E.; THOMA, R. S. ***Measurement of the Capacity of MIMO Systems in Frequency-selective Channels***. Vehicular Technology Conference, 2001. VTC 2001 Spring. IEEE VTS 53rd, Vol. 1, pp. 204-208, 6-9 May 2001.
- [60] KRIM, H.; VIBERG, M. ***Two Decades of Array Signal Processing Research***. IEEE Signal Processing Mag., pp. 67-94, July 1996.
- [61] SCHMIDT, R. O. ***Multiple Emitter Location and Signal Parameter Estimation***. IEEE Trans. Antennas Propagat. Vol. AP-34, pp. 276-280, Mar.1986.
- [62] ROY, R.; KAILATH, T. ***ESPRIT – Estimation of Signal Parameters via Rotational Invariance Techniques***. IEEE Trans. Acoust., Speech, Signal Processing, Vol. 37, pp. 984-995, July 1989.
- [63] HAARDT, M.; NOSSEK, J. ***Unitary ESPRIT: How to Obtain Increased Estimation Accuracy with a Reduced Computational Burden***. IEEE Trans. Signal Processing, Vol. SP-43, pp. 1232-1242, May 1995.
- [64] VAN DER VEEN, A.; VANDERVEEN, M.; PAULRAJ, A. ***Joint Angle and Delay Estimation using Shift-invariance Properties***. IEEE Signal Processing Lett., Vol. 4, pp. 142-145, May 1997.
- [65] ZOLTOWSKI, M.; HAARDT, M.; MATHEWS, C. ***Closed-form 2-D Angle Estimation with Rectangular Arrays in Element Space or Beamspace via Unitary ESPRIT***. IEEE Trans. Signal Processing, Vol. SP-44, pp. 316-328, Feb. 1996.
- [66] SHIANN, J.; INGRAM, M. A. ***Path Models and MIMO Capacity for Measured Indoor Channels at 5.8 GHz***.

- [67] FEDER, M.; WEINSTEIN, E. ***Parameter Estimation of Superimposed Signals using the EM Algorithm***. IEEE Trans. Acoust., Speech, Signal Processing, Vol. 36, pp. 477-489, Apr. 1988.
- [68] FESSLER, J. A.; HERO, A. O. ***Space-Alternating Generalized Expectation-Maximization Algorithm***. IEEE Transactions on Signal Processing, Vol. 42, October 1994.
- [69] VAN TREES, H. L. ***Optimum Array Processing***. Part IV. Wiley-Interscience, 2002.
- [70] FLEURY, B. H.; DAHLHAUS, D.; HEDDERGOTT, R.; TSCHUDIN, M. ***Wideband Angle of Arrival Estimation using the SAGE Algorithm***. In Proc. IEEE Fourth Int. Symp. Spread Spectrum Techniques and Applications (ISSSTA '96), pp. 79-85, Mainz, Germany, Sept. 1996.
- [71] PEDERSEN, K.; FLEURY, B.; MOGENSEN, P. ***High Resolution of Electromagnetic Waves in Time-varying Radio Channels***. In Proc. 8th IEEE Int. Symp. Personal, Indoor and Mobile Radio Communications (PIMRC '97), Helsinki, Finland, Sept. 1997.
- [72] FLEURY, B. H.; TSCHUDIN, M.; HEDDERGOTT, R.; DAHLHAUS, D.; PEDERSEN, K. I. ***Channel Parameter Estimation in Mobile Radio Environments using the SAGE Algorithm***. IEEE Journal on Select. Areas Commun., Vol. 17, n. 3, Mar. 1999.
- [73] TSCHUDIN, M.; HEDDERGOTT, R.; TRUFFER, P. ***Validation of a High Resolution Measurement Technique for Estimating the Parameters of Impinging Waves in Indoor Environments***. In Proceedings 9th IEEE Int. Symp. Personal, Indoor and Mobile Radio Communications (PIMRC '98), pp. 1411-1416, Boston, MA, Sept. 1998.
- [74] FLEURY, B. H.; JOURDAN, P.; STUCKI, A. ***High Resolution Channel Parameter Estimation for MIMO Applications using the SAGE Algorithm***. 2002 International Zurich Seminar on Broadband Communications Access-Transmission-Networking, February 19-21 2002, ETH Zurich Switzerland.

- [75] CHONG, C.; LAURENSEN, D. I.; TAN, C. M.; MCLAUGHLIN, S.; BEACH, M. A.; NIX, A. R. ***Joint Detection-estimation of Directional Channel Parameters using the 2-D Frequency Domain SAGE Algorithm with Serial Interference Cancellation***. In Proc. IEEE Intl. Conf. Commun. (ICC 2002), Vol. 2, New York, USA, Apr. 2002.
- [76] HANEDA, K; TAKADA, J. ***High Resolution Estimation of NLOS Indoor MIMO Channel with Network Analyzer Based System***.
- [77] SOUZA, E. E.; JOVANOVIĆ, V.; DAIGNEAULT, C. ***Delay Spread Measurements for the Digital Cellular Channel in Toronto***. IEEE Transactions on Vehicular Technology. Vol. 43, November, 1994.
- [78] KATSUYUKI HANEDA; JUN-ICHI TAKADA; TAKEHIKO KOBAYASHI. ***Experimental Evaluation of a SAGE Algorithm for Ultra Wideband Channel Sounding in an Anechoic Chamber***.
- [79] KURPJUH, T. P.; UTSCHICK, W. ***MIMO Channel Sounding Taking into Account Small Angular Spread***. PIMRC 2002. pp. 2302-2306.
- [80] FLEURY, B. H. ***First and Second-Order Characterization of Direction Dispersion and Space Selectivity in the Radio Channel***. IEE Transaction on Information Theory, Vol. 46, n. 06, September 2000.
- [81] PARSONS, J. D. ***The Mobile Radio Propagation Channel***. John Wiley & Sons Ltda, 2nd. Edition, 2002.
- [82] DURGIN, G. D. ***Space-time Wireless Channel***. Prentice Hall, 2003.
- [83] PAULRAJ, A.; NABAR, R.; GORE, D. ***Introduction to Space-time Wireless Communication***. Cambridge University Press. 2003.
- [84] MACEDO, L. H. G. de. ***Sondagem em Frequência do Canal Indoor de Faixa Larga***. Dissertação de Mestrado, Departamento de Engenharia Elétrica, PUC-Rio. Fevereiro de 2002.
- [85] MACEDO, J. F. ***Caracterização Espaço-temporal do Canal Rádio Móvel: Uma Implementação da Sondagem em Frequência***. Dissertação de Mestrado, Departamento de Engenharia Elétrica, PUC-Rio. Fevereiro de 2003.