

## Romain Couillet

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### CONTACT

Professeur des Universités  
CentraleSupélec, LSS Pôle Signaux et Statistiques

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### DATE DE NAISSANCE

18 mars 1983.

### NATIONALITÉ

Française

### RECHERCHE

**Sujets de recherche:** statistiques; théorie des matrices aléatoires; apprentissage automatique; graphes; traitement du signal; applications aux mégadonnées.

**Résumé:** Le sujet de mes recherches concerne l'analyse théorique et le développement d'algorithmes innovants pour les statistiques, le traitement du signal, l'apprentissage automatisé et les grands graphes aléatoires. Plus spécifiquement, mes travaux portent sur l'analyse théorique en grande dimension, notamment via la théorie des matrices aléatoires, des modèles saillants dans ces domaines (matrices d'adjacence de graphes, réseaux de neurones aléatoires et profonds, méthodes à noyaux, estimateurs de covariance en statistiques robustes et applications à la finance ou au traitement d'antennes, ou encore grands réseaux de télécommunications). Mes principaux résultats théoriques et appliqués sont: (i) en apprentissage, l'introduction d'un nouvel outil d'analyse des méthodes de classification à noyaux ainsi que de nouvelles techniques théoriques d'analyse des performances de grands réseaux de neurones aléatoires, (ii) en statistiques, l'introduction d'un nouveau paradigme de statistiques robustes en grandes dimensions, avec notamment des algorithmes innovants pour la finance et les radars modernes, (iii) pour les réseaux d'antennes et capteurs, des méthodes améliorées pour le traitement du signal (détection, estimation) dans des contextes de bruit impulsif, et (iv) en télécommunications, l'analyse et le développement de solutions pratiques pour atteindre la capacité de systèmes à utilisateurs et antennes multiples.

Ces travaux ont donné lieu à plus de quarante publications dans des journaux à portée internationale (dans des revues mathématiques, d'apprentissage automatique, de traitement du signal et de théorie de l'information: *Journal of Multivariate Analysis*, *Journal of Machine Learning Research*, *IEEE Trans. on Information Theory* et *IEEE Trans. on Signal Processing* notamment), à plus de soixante articles publiés dans des conférences de rang international, et à un livre de 650 pages publié par Cambridge University Press. En 2011, j'ai reçu le prix de la meilleure thèse en traitement du signal et de l'image délivré par les clubs EEA/GdR ISIS/GRETSI. En 2012, M. Debbah (PI) et moi-même avons reçu une ERC Starting Grant (projet MORE) avant de recevoir moi-même, entre autres projets de moindre envergure ou collaboratifs, en 2014 une bourse ANR Jeune Chercheur (projet RMT4GRAPH).

En 2013, j'ai reçu la médaille de Bronze du CNRS dans la section "science de l'information et ses interactions" ainsi que le prix IEEE ComSoc Outstanding Young Researcher for the Europe/Middle-East/Africa region.

ETUDES ET  
DIPLOMES

**Université d'Orsay**, Saclay, France.

**Janvier 2011 - Février 2015**

HDR en Physique

- Titre: Méthodes d'estimation robuste dans le régime des grandes matrices aléatoires
- Jury: A. Hero, L. Pastur, J-Y. Tourneret (rapporteurs), F. Benaych-Georges, P. Bondon, M. McKay, E. Ollila.

**CentraleSupélec**, Gif sur Yvette, France.

**Janvier 2008 - Novembre 2010**

Thèse, spécialité Physique (**Télécommunications**), Novembre 2010

- Titre: Application de la théorie des matrices aléatoires aux futurs réseaux flexibles de communications sans fils
- Directeur de thèse: **Professeur Mérouane Debbah**
- Jury: P. Loubaton, X. Mestre (rapporteurs), M. Debbah, P. Duhamel, W. Hachem, A. Moustakas, J. Silverstein.

**Telecom ParisTech**, Paris, France.

**Septembre 2004 - Juin 2007**

Master Science, **Systèmes de Communications**, (mention TB), Mars 2008

- Communications sans fils
- Traitement d'image
- Techniques de détection aveugles

**Institut Eurecom**, Sophia Antipolis, France.

**Septembre 2005 - Juin 2007**

Diplôme d'ingénieur, **Ingénierie des télécommunications**, Septembre 2007

- Communications mobiles
- Systèmes embarqués
- Informatique

**Lycée Louis le Grand**, Paris, France.

**Septembre 2001 - Juin 2004**

Classe préparatoire aux grandes écoles

EXPÉRIENCE  
PROFESSIONNELLE

**Université Grenoble-Alpes**, Saint-Martin d'Hères, France.

*Titulaire de la chaire IDEX en datascience GSTATS*

**Avril 2018 - Présent**

- Recherche en théorie des matrices aléatoires appliquées à l'apprentissage en grandes dimensions.
- Enseignement dans les masters en science des données.

**CentraleSupélec**, Gif sur Yvette, France.

*Professeur des Universités*

**Janvier 2011 - Présent**

- Recherche en mathématiques appliquées aux statistiques, apprentissage et traitement du signal.
- Enseignement en cycle ingénieur, Master 2 (SAR et MVA) et thèse.

**ST-Ericsson**, Sophia Antipolis, France.

*Ingénieur R&D et thésard*

**Septembre 2007 - Décembre 2010**

- Recherche en radios cognitives, théorie des matrices aléatoires, probabilités, appliquée aux futurs standards MIMO.
- Applications à la synchronisation de terminaux mobiles, à l'évaluation des performances des standards UMTS et LTE/LTE-A.

*Stagiaire (Développement firmware DSP)*

**Mars 2007 - Août 2007**

- Développement d'une solution d'ordonnancement de tâches audios.
- Mise en place d'un système de correction d'erreurs audio sur DSP.

**Institut Eurecom**, Sophia Antipolis, France.

*Chercheur stagiaire*, avec R. Knopp

**Juillet 2006 - Août 2006**

- Implémentation logicielle d'une FFT à radix 2-4.
- Portage sur DSP du programme logiciel.

## ENSEIGNEMENT

**ENS Cachan**, Cachan, France.

*Matrices aléatoires et applications à l'apprentissage*

**Depuis 2013**

- Niveau Master 2, cours magistraux, 24 heures

**CentraleSupélec**, Gif sur Yvette, France.

*Introduction à la théorie des matrices aléatoires*

**Depuis 2012**

- Niveau Master 2, séminaires 12 heures

*Fondations théoriques des réseaux radio flexibles*

**Since 2012**

- Niveau Master 2, séminaires 12 heures

*Techniques de rédaction scientifique*

**Depuis 2012**

- Niveaux thèse et 2e année du cycle ingénieur, cours, 18+12 heures

*TD et TP de filtrage, signaux, statistiques*

**Depuis 2012**

- Niveaux 1ère-2e année du cycle ingénieur, 72 heures

*Introduction aux matrices aléatoires*

**Automne 2009/2011**

- Niveau thèse, cours, 18 heures

**Polytech Nice-Sophia**, Sophia-Antipolis, France.

*Communications numériques*

**Printemps 2010**

- Niveau Master, cours, 24 heures

*Filtrage numérique*

**Printemps 2010**

- Niveau Master, cours, 60 heures

## COMMUNAUTÉ

### IEEE

|   |                    |
|---|--------------------|
| Membre IEEE Senior (membre depuis 2007)                                     | <b>depuis 2015</b> |
| Editeur associé pour IEEE TSP   | <b>depuis 2015</b> |
| Membre du comité technique IEEE STPM  | <b>depuis 2015</b> |
| Technical Area Chair à IEEE Asilomar'16                                     | <b>2016</b>        |
| Organisateur de 3 sessions spéciales à IEEE Asilomar'13, SSP'14, and SSP'16 |                    |

### GRETSI

|   |                    |
|---|--------------------|
| Membre de l'association GRETSI                                      | <b>depuis 2011</b> |
| Editeur pour le numéro spécial "Matrices aléatoires" de la revue TS | <b>2015</b>        |

### GDR ISIS

|   |             |
|---|-------------|
| Co-organisateur de la journée GdR "Estimation et traitement statistique en grande dimensions" | <b>2013</b> |
|---|-------------|

## PRIX

Médaille de bronze du CNRS.

*Médaille de Bronze 2013 du CNRS dans la section INS2I.*

- Récompense mes travaux de jeune chercheur en traitement du signal et communications mobiles depuis 2008.
- *Année: 2013.*

Prix de jeune chercheur IEEE ComSoc

*2013 IEEE ComSoc Outstanding Young Researcher Award for the EMEA Region*

- Récompense mes travaux de jeune chercheur en communications mobiles depuis 2008.
- *Année: 2013.*

Prix de meilleure thèse.

*Prix EEA/GdR ISIS/GRETSI 2011 de la meilleure thèse 2010*

- "Application de la théorie des matrices aléatoires aux futurs réseaux flexibles de communications sans fil"
- *Année: 2011.*

Meilleur article étudiant.

*Second prix du 2012-2013 IEEE Australia Council Student Paper Contest*

- "Large System Analysis of Linear Precoding in MISO Broadcast Channels with Confidential Messages"
- *Détenteurs: G. Geraci, R. Couillet, J. Yuan, M. Debbah, I. B. Collings.*
- *Année: 2013.*

Meilleur article étudiant.

*Finaliste du Best Student Paper Award de la conférence Asilomar 2011*

- "Asymptotic Analysis of Double-Scattering Channels"
- *Détenteurs: J. Hoydis, R. Couillet, M. Debbah.*
- *Année: 2011.*

Meilleur article étudiant.

*Meilleur article étudiant de la conférence ValueTools 2008*

- “The Space Frontier: Physical Limits of Multiple Antenna Information Transfer”
- *Détenteurs*: R. Couillet, S. Wagner, M. Debbah, A. Silva.
- *Année*: 2008.

## PUBLICATIONS

*Chiffres Google Scholar de Fév. 2017.*

**Global** 1 livre, 3 chapitres, 40+ revues, 60+ conférences, 4 brevets.  
**Citations** ~ 1750 (cinq meilleures: 402, 293, 105, 59, 52)  
**h-index** 17  
**i10-index** 30

## ARTICLES AVEC COMITÉ DE RELECTURE

- J1. R. Couillet, M. Tiomoko, S. Zozor, E. Moisan, “[Random matrix-improved estimation of covariance matrix distances](#)”, (submitted to) *Journal of Multivariate Analysis*, 2018.
- J2. X. Mai, R. Couillet, “[A random matrix analysis and improvement of semi-supervised learning for large dimensional data](#)”, (submitted to) *Journal of Machine Learning Research*, 2017.
- J3. A. Kammoun, R. Couillet, “[Subspace Kernel Clustering of Large Dimensional Data](#)” (submitted to) *Annals of Applied Probability*, 2017.
- J4. L. Yang, M. McKay, R. Couillet, “[High-Dimensional MVDR Beamforming: Optimized Solutions based on Spiked Random Matrix Models](#)”, *IEEE Transactions on Signal Processing*, vol. 66, no. 1, pp. 1933-1947, 2018.
- J5. A. Karadimitrakis, A. L. Moustakas, R. Couillet, “[Gallager Bound for MIMO Channels: Large-N Asymptotics](#)” *IEEE Transactions on Wireless Communications*, vol. 17, no. 2, pp. 1323-1330, 2018.
- J6. N. Auguin, D. Morales, M. McKay, R. Couillet, “[Large-dimensional behavior of regularized Maronna’s M-estimators of covariance matrices](#)” (submitted to) *IEEE Transactions on Signal Processing*, 2017.
- J7. C. Louart, Z. Liao, R. Couillet, “[A Random Matrix Approach to Neural Networks](#)” *Annals of Applied Probability*, vol. 28, no. 2, pp. 1190–1248, 2018.
- J8. Z. Liao, R. Couillet, “[A Large Dimensional Analysis of Least Square Support Vector Machines](#)” (submitted to) *Journal of Machine Learning Research*, 2017.
- J9. R. Couillet, H. Tiomoko Ali, “[Improved spectral community detection in large heterogeneous networks](#)” *Journal of Machine Learning Research*, vol. 18, no. 225, pp. 1–49, 2018.
- J10. R. Couillet, M. McKay, “[Optimal block-sparse PCA for high dimensional correlated samples](#)” (submitted to) *Journal of Multivariate Analysis*, 2016.
- J11. R. Couillet, G. Wainrib, H. Sevi, H. Tiomoko Ali, “[The asymptotic performance of linear echo state neural networks](#)” *Journal of Machine Learning Research*, vol. 17, no. 178, pp. 1-35, 2016.

- J12. R. Couillet, F. Benaych-Georges, “Kernel Spectral Clustering of Large Dimensional Data” *Electronic Journal of Statistics*, vol. 10, no. 1, pp. 1393-1454, 2016.
- J13. F. Benaych-Georges, R. Couillet, “Spectral Analysis of the Gram Matrix of Mixture Models” *ESAIM: Probability and Statistics*, DOI <http://dx.doi.org/10.1051/ps/2016007>, 2016.
- J14. R. Couillet, *Estimation robuste et matrices aléatoires*, revue *Traitement du Signal*, vol. 33, no. 2-3, pp. 273-320, 2016.
- J15. R. Couillet, G. Wainrib, *Perspectives en matrices aléatoires et grands réseaux*, revue *Traitement du Signal*, vol. 33, no. 2-3, pp. 351-376, 2016.
- J16. M. Sadeghi, L. Sanguinetti, R. Couillet, Y. Chau, “Large System Analysis of Power Normalization Techniques in Massive MIMO”, *IEEE Transactions on Vehicular Technologies*, vol. 66, no. 10, pp. 9005-9017, 2017.
- J17. M. Sadeghi, L. Sanguinetti, R. Couillet, Y. Chau, “Reducing the Computational Complexity of Multicasting in Large-Scale Antenna Systems”, *IEEE Transactions on Wireless Communications*, vol. 16, no. 5, pp. 2963-2975, 2017.
- J18. L. Sanguinetti, R. Couillet, M. Debbah, “Large System Analysis of Base Station Cooperation for Power Minimization” *IEEE Transactions on Wireless Communications*, vol. 15, no. 8, pp. 5480-5496, 2016.
- J19. A. Abboud, F. Iutzeler, R. Couillet, H. Siguerdidjane, M. Debbah, “Distributed Production-Sharing Optimization and Application to Power Grid Networks,” *IEEE Transactions on Signal and Information Processing over Networks*, vol. 2, no. 1, pp. 1628, 2016.
- J20. A. Kammoun, R. Couillet, F. Pascal, M.-S. Alouini, “Optimal Design of the Adaptive Normalized Matched Filter Detector using Regularized Tyler Estimator” (in Press) *IEEE Transactions on Aerospace and Electronic Systems*, 2016, arXiv Preprint 1504.01252.
- J21. A. Kammoun, R. Couillet, F. Pascal, M.-S. Alouini, “Convergence and Fluctuations of Regularized Tyler Estimators” *IEEE Transactions on Signal Processing*, vol. 64, no. 4, pp. 1048-1060, 2016.
- J22. D. Morales-Jimenez, R. Couillet, M. McKay, “Large Dimensional Analysis of Robust M-Estimators of Covariance with Outliers” *IEEE Transactions on Signal Processing*, vol. 63, no. 21, pp. 5784-5797, 2015.
- J23. L. Yang, R. Couillet, M. McKay, “A Robust Statistics Approach to Minimum Variance Portfolio Optimization” *IEEE Transactions on Signal Processing*, vol. 63, no. 24, pp. 6684–6697, 2015.
- J24. R. Couillet, A. Kammoun, F. Pascal, “Second order statistics of robust estimators of scatter. Application to GLRT detection for elliptical signals” *Elsevier Journal of Multivariate Analysis*, vol. 143, pp. 249-274, 2015.

- J25. A. Müller, R. Couillet, E. Björnson, S. Wagner, M. Debbah, “Interference-Aware RZF Precoding for Multi-Cell Downlink Systems” *IEEE Transactions on Signal Processing*, vol. 63, no. 15, pp. 3959-3973 2015.
- J26. R. Couillet, “Robust spiked random matrices and a robust G-MUSIC estimator” *Elsevier Journal of Multivariate Analysis*, vol. 140, pp. 139-161, 2015.
- J27. R. Couillet, M. McKay, “Large Dimensional Analysis and Optimization of Robust Shrinkage Covariance Matrix Estimators” *Elsevier Journal of Multivariate Analysis*, vol. 131, pp. 99-120, 2014.
- J28. Y. Chitour, R. Couillet, F. Pascal “On the convergence of Maronna’s M-estimators of scatter” *IEEE Signal Processing Letters*, vol. 22, no. 6, pp. 709-712, 2014.
- J29. R. Couillet, F. Pascal, J. W. Silverstein, “The Random Matrix Regime of Maronna’s M-estimator with elliptically distributed samples”, vol. 139, pp. 56-78, *Elsevier Journal of Multivariate Analysis*, 2015.
- J30. J. Vinogradova, R. Couillet, W. Hachem, “Estimation of Toeplitz covariance matrices in large dimensional regime with application to source detection large”, *IEEE Transactions on Signal Processing*, vol. 63, no. 18, pp. 4903-4913, 2015.
- J31. R. Couillet, W. Hachem, “Analysis of the limiting spectral measure of large random matrices of the separable covariance type”, *Random Matrix Theory and Applications*, vol. 3, pp. 1-23, 2014.
- J32. J. Hoydis, R. Couillet, P. Piantanida, “The Second-Order Coding Rate of the MIMO Rayleigh Block-Fading Channel,” *IEEE Transactions on Information Theory*, vol. 61, no. 12, pp. 6591-6622, 2015.
- J33. J. Vinogradova, R. Couillet, W. Hachem, “Statistical Inference in Large Antenna Arrays under Unknown Noise Pattern,” *IEEE Transactions on Signal Processing*, vol. 61, no. 22, pp. 5633-5645, 2013.
- J34. F. Chapon, R. Couillet, W. Hachem, X. Mestre, “The outliers among the singular values of large rectangular random matrices with additive fixed rank deformation,” *Markov Processes and Related Fields*, vol. 20, pp. 183-228, 2014.
- J35. R. Couillet, F. Pascal, J. W. Silverstein, “Robust Estimates of Covariance Matrices in the Large Dimensional Regime,” *IEEE Transactions on Information Theory*, vol. 60, no. 11, 2014.
- J36. G. Geraci, R. Couillet, J. Yuan, M. Debbah, I. B. Collings, “Large System Analysis of Linear Precoding in MISO Broadcast Channels with Confidential Messages,” *IEEE Journal on Selected Area in Communications*, vol. 31, no. 9, pp. 1660-1671, 2013. **Second prize of the 2012-2013 IEEE Australia Council Student Paper Contest.**
- J37. J. Hoydis, R. Couillet, M. Debbah, “Iterative Deterministic Equivalents for the Capacity Analysis of Communication Systems,” *Technical Report*.

- J38. R. Couillet, S. Medina Perlaza, H. Tembine, M. Debbah, “[Electrical Vehicles in the Smart Grid: A Mean Field Game Analysis](#),” *IEEE Journal on Selected Areas in Communications: Smart Grid Communications Series*, vol. 30, no. 6, pp. 1086-1096, 2012.
- J39. J. Yao, R. Couillet, J. Najim, M. Debbah, “[Fluctuations of an Improved Population Eigenvalue Estimator in Sample Covariance Matrix Models](#),” *IEEE Transactions on Information Theory*, vol. 59, no. 2, pp. 1149-1163, 2013.
- J40. R. Couillet, M. Debbah, “[Signal Processing in Large Systems: a New Paradigm](#),” *IEEE Signal Processing Magazine*, vol. 30, no. 1, pp. 24-39, 2013.
- J41. R. Couillet, W. Hachem, “[Fluctuations of spiked random matrix models and failure diagnosis in sensor networks](#),” *IEEE Transactions on Information Theory*, vol. 59, no. 1, pp. 509-525, 2013.
- J42. A. Kammoun, R. Couillet, J. Najim, M. Debbah, “[Performance of capacity inference methods under colored interference](#),” *IEEE Transactions on Information Theory*, vol. 59, no. 2, pp. 1129-1148, 2013.
- J43. R. Couillet, J. Hoydis, M. Debbah, “[Random beamforming over quasi-static and fading channels: A deterministic equivalent approach](#),” *IEEE Transactions on Information Theory*, vol. 58, no. 10, pp. 6392-6425, 2012.
- J44. S. Wagner, R. Couillet, M. Debbah, D. T. M. Slock, “[Large System Analysis of Linear Precoding in MISO Broadcast Channels with Limited Feedback](#)”, *IEEE Transactions on Information Theory*, vol. 58, no. 7, pp. 4509-4537, 2012.
- J45. R. Couillet, J. W. Silverstein, Z. Bai, M. Debbah, “[Eigen-Inference for Energy Estimation of Multiple Sources](#)”, *IEEE Transactions on Information Theory*, vol. 57, no. 4, pp. 2420-2439, 2011.
- J46. R. Couillet, M. Debbah, J. W. Silverstein, “[A Deterministic Equivalent for the Analysis of Correlated MIMO Multiple Access Channels](#)”, *IEEE Transactions on Information Theory*, vol. 57, no. 6, pp. 3493-3514, 2011.
- J47. R. Couillet, M. Debbah, “[A Bayesian Framework for Collaborative Multi-Source Signal Sensing](#)”, *IEEE Transactions on Signal Processing*, vol. 58, no. 10, pp. 5186-5195, 2010.
- J48. R. Couillet, A. Ancora, M. Debbah, “[Bayesian Foundations of Channel Estimation for Cognitive Radios](#)”, *Advances in Electronics and Telecommunications*, vol. 1, no. 1, pp. 41-49, 2010.
- J49. R. Couillet, M. Debbah, “[Le téléphone du futur : plus intelligent pour une exploitation optimale des fréquences](#)” *Revue de l'Electricité et de l'Electronique*, no. 6, pp. 71-83, 2010.
- J50. R. Couillet, M. Debbah, “[Mathematical foundations of cognitive radios](#)”, *Journal of Telecommunications and Information Technologies*, no. 4, 2009.



- J51. R. Couillet, M. Debbah, “[Outage performance of flexible OFDM schemes in packet-switched transmissions](#)”, *Eurasip Journal on Advances on Signal Processing*, Volume 2009, Article ID 698417, 2009.
- C1. L. Dall’Amico, R. Couillet “[Community Detection in Sparse Realistic Graphs: Improving the Bethe Hessian](#)”, (submitted to) *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’19)*, Brighton, UK, 2019.
- C2. X. Mai, R. Couillet “[Revisiting and Improving Semi-Supervised Learning: A Large Dimensional Approach](#)”, (submitted to) *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’19)*, Brighton, UK, 2019.
- C3. H. Tiomoko Ali, S. Liu, Y. Yilmaz, R. Couillet, I. Rajapakse, A. Hero, “[Latent Heterogeneous Multilayer Community Detection](#)”, (submitted to) *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’19)*, Brighton, UK, 2019.
- C4. Z. Liao, X. Mai, R. Couillet “[A Large  \$n, p\$  Analysis of Logistic Regression: Asymptotic Performance and New Insights](#)”, (submitted to) *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’19)*, Brighton, UK, 2019.
- C5. M. Tiomoko, R. Couillet, S. Zozor, E. Moisan, “[Improved Estimation of the Distance between Covariance Matrices](#)”, (submitted to) *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’19)*, Brighton, UK, 2019.
- C6. R. Couillet, Z. Liao, X. Mai, “[Classification Asymptotics in the Random Matrix Regime](#)”, *European Signal Processing Conference (EUSIPCO’18)*, Rome, Italy, 2018.
- C7. M. Seddik, M. Tamaazousti, R. Couillet, “[A Kernel Random Matrix-Based Approach for Sparse PCA](#)”, (submitted to) *Neural Information Processing Systems (NIPS’18)*, Montreal, Canada, 2018.
- C8. X. Mai, R. Couillet, “[Efficient Graph-based Semi-Supervised Learning by Centered Kernel Regularization](#)”, (submitted to) *Neural Information Processing Systems (NIPS’18)*, Montreal, Canada, 2018.
- C9. Z. Liao, Y. Chitour, R. Couillet, “[Almost Global Convergence to Global Minima for Gradient Descent in Deep Linear Networks](#)”, (submitted to) *Neural Information Processing Systems (NIPS’18)*, Montreal, Canada, 2018.
- C10. X. Mai, R. Couillet, “[Semi-Supervised Spectral Clustering](#)”, (submitted to) *Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, CA, USA, 2018.
- C11. Z. Liao, R. Couillet, “[The Dynamics of Learning: A Random Matrix Approach](#)”, (submitted to) *International Conference on Machine Learning*, Stockholm, Sweden, 2018.
- C12. Z. Liao, R. Couillet, “[On the Spectrum of Random Features Maps of High Dimensional Data](#)”, (submitted to) *International Conference on Machine Learning*, Stockholm, Sweden, 2018.

- C13. H. Tiomoko Ali, A. Kammoun, R. Couillet, “[Random matrix-improved kernels for large dimensional spectral clustering](#)”, (submitted to) Statistical Signal Processing Workshop (SSP’18), Freiburg, Germany, 2018.
- C14. L. Yang, M. R. McKay, R. Couillet, “[Random Matrix-Optimized High-Dimensional MVDR Beamforming](#)”, (submitted to) Statistical Signal Processing Workshop (SSP’18), Freiburg, Germany, 2018.
- C15. C. Louart, R. Couillet, “[A Random Matrix and Concentration Inequalities Framework for Neural Networks Analysis](#)”, (submitted to) IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’18), Calgary, Canada, 2018.
- C16. H. Tiomoko Ali, A. Kammoun, R. Couillet, “[Random matrix asymptotic of inner product kernel spectral clustering](#)”, (submitted to) IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’18), Calgary, Canada, 2018.
- C17. K. Elkalil, A. Kammoun, R. Couillet, T. Al-Naffouri, M.-S. Alouini, “[Asymptotic Performance of Regularized Quadratic Discriminant Analysis Based Classifiers](#)”, IEEE International Workshop on Machine Learning for Signal Processing (MLSP’17), Roppongi, Tokyo, Japan, 2017. **Best student paper award finalist**
- C18. Z. Liao, R. Couillet, “[Random matrices meet machine learning: a large dimensional analysis of LS-SVM](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’17), New Orleans, USA, 2017.
- C19. X. Mai, R. Couillet, “[The counterintuitive mechanism of graph-based semi-supervised learning in the big data regime](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’17), New Orleans, USA, 2017.
- C20. C. Louart, R. Couillet, “[Harnessing neural networks: a random matrix approach](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’17), New Orleans, USA, 2017.
- C21. H. Tiomoko Ali, R. Couillet, “[Random Matrix Improved Community Detection in Heterogeneous Networks](#)”, Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2016.
- C22. R. Couillet, A. Kammoun, “[Random Matrix Improved Subspace Clustering](#)”, Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2016.
- C23. R. Couillet, G. Wainrib, H. Sevi, H. Tiomoko Ali, “[A Random Matrix Approach to Recurrent Neural Networks](#)”, International Conference on Machine Learning (ICML), New York, USA, 2016.
- C24. A. Kammoun, R. Couillet, F. Pascal, M. Slim-Alouini, “[Optimal Design of Adaptive Normalized Matched Filter For Large Antenna Arrays](#)”, IEEE Statistical Signal Processing Workshop (SSP), Palma de Majorca, Spain, 2016.
- C25. N. Auguin, D. Morales, M. R. McKay, R. Couillet, “[Robust Shrinkage M-estimators of Large Covariance Matrices](#)”, IEEE Statistical Signal Processing Workshop (SSP), Palma de Majorca, Spain, 2016.

- C26. R. Couillet, G. Wainrib, H. Sevi, H. Tiomoko Ali, “[Training performance of echo state neural networks](#)”, IEEE Statistical Signal Processing Workshop (SSP), Palma de Majorca, Spain, 2016.
- C27. H. Tiomoko Ali, R. Couillet, “[Performance analysis of spectral community detection in realistic graph models](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’16), Shanghai, China, 2016.
- C28. R. Couillet, F. Benaych-Georges, “[Understanding Big Data Spectral Clustering](#)”, IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), Cancun, Mexico, 2015.
- C29. L. Yang, R. Couillet, M. R. McKay, “[Minimum Variance Portfolio Optimization in the Spiked Covariance Model](#)”, IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), Cancun, Mexico, 2015.
- C30. L. Sanguinetti, R. Couillet, M. Debbah, “[Base Station Cooperation for Power Minimization in the Downlink: Large System Analysis](#)”, IEEE Global Communications Conference (GLOBECOM’15), San Diego, USA, 2015.
- C31. R. Couillet, M. S. Greco, J-P. Ovarlez, F. Pascal, “[RMT for Whitening Space Correlation and Applications to Radar Detection](#)”, IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), Cancun, Mexico, 2015.
- C32. D. Morales-Jimenez, R. Couillet, M. McKay, “[Large dimensional analysis of Maronna’s M-estimator with outliers](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’15), Brisbane, Australia, 2015.
- C33. A. Kammoun, R. Couillet, F. Pascal, “[Second order statistics of bilinear forms of robust scatter estimators](#)”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’15), Brisbane, Australia, 2015.
- C34. G. Katz, P. Piantanida, R. Couillet, “[Joint Estimation and Detection Against Independence](#)”, Fifty-second Allerton Conference on Communication, Control, and Computing, Allerton, IL, USA, 2014.
- C35. R. Couillet, M. McKay, “[Robust covariance estimation and linear shrinkage in the large dimensional regime](#)”, IEEE International Workshop on Machine Learning for Signal Processing (MLSP’14), Reims, France, 2014.
- C36. L. Yang, R. Couillet, M. McKay, “[Minimum variance portfolio optimization with robust shrinkage covariance estimation](#)”, Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2014.
- C37. P. Vallet, X. Mestre, Ph. Loubaton, R. Couillet, “[Asymptotic analysis of Beamspace-MUSIC in the context of large arrays](#)”, IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM’14), A Coruna, Spain, 2014.
- C38. R. Couillet, A. Kammoun, “[Robust G-MUSIC](#)”, European Signal Processing Conference (EUSIPCO’14), Lisbon, Portugal, 2014.

- C39. J. Vinogradova, R. Couillet, W. Hachem, “Estimation of Large Toeplitz Covariance Matrices and Application to Source Detection”, European Signal Processing Conference (EUSIPCO’14), Lisbon, Portugal, 2014.
- C40. R. Couillet, F. Pascal, “Robust M-estimator of scatter for large elliptical samples”, IEEE Workshop on Statistical Signal Processing (SSP’14), Gold Coast, Australia, 2014.
- C41. A. Abboud, R. Couillet, M. Debbah, H. Siguerdidjane, “Asynchronous alternating direction method of multipliers applied to the direct-current optimal power flow problem,” IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’14), Florence, Italy, 2014.
- C42. A. Pelletier, R. Couillet, J. Najim, “Second-Order Analysis of the Joint SINR distribution in Rayleigh Multiple Access and Broadcast Channels,” Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2013.
- C43. A. Müller, E. Björnson, R. Couillet, M. Debbah, “Analysis and management of heterogeneous user mobility in large-scale downlink systems,” Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, USA, 2013.
- C44. J. Hoydis, R. Couillet, P. Piantanida, “Bounds on the Second-Order Coding Rate of the MIMO Rayleigh Block-Fading Channel,” IEEE International Symposium on Information Theory, Istanbul, Turkey, 2013.
- C45. G. Geraci, R. Couillet, J. Yuan, M. Debbah, I. Collings, “Secrecy Sum-Rates with Regularized Channel Inversion Precoding under Imperfect CSI at the Transmitter,” IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’13), Vancouver, Canada, 2013.
- C46. R. Couillet, F. Pascal, J. W. Silverstein, “A Joint Robust Estimation and Random Matrix Framework with Application to Array Processing,” IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’13), Vancouver, Canada, 2013.
- C47. J. Vinogradova, R. Couillet, W. Hachem, “A new method for source detection, power estimation, and localization in large sensor networks under noise with unknown statistics,” IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’13), Vancouver, Canada, 2013.
- C48. M. de Mari, R. Couillet, M. Debbah, “Concurrent data transmissions in green wireless networks: when best send one’s packets?,” (Invited paper) IEEE International Symposium on Wireless Communication Systems (ISWCS’12), Paris, France, 2012.
- C49. A. Müller, J. Hoydis, R. Couillet, M. Debbah, “Optimal 3D Cell Planning: A Random Matrix Approach,” IEEE Global Communications Conference (GLOBECOM’12), Anaheim, California, USA, 2012.
- C50. J. Hoydis, R. Couillet, P. Piantanida, M. Debbah, “A Random Matrix Approach to the Finite Blocklength Regime of MIMO Fading Channels,” IEEE International Symposium on Information Theory, Boston, Massachusetts, USA, 2012.

- C51. M. Rezaee, R. Couillet, M. Guillaud, G. Matz, “Sum-Rate Optimization for the MIMO IC under Imperfect CSI: a Deterministic Equivalent Approach,” IEEE International Workshop on Signal Processing Advances for Wireless Communications, Cesme, Turkey, 2012.
- C52. J. Hoydis, A. Müller, R. Couillet, M. Debbah, “Analysis of Multicell Cooperation with Random User Locations Via Deterministic Equivalents,” Eighth Workshop on Spatial Stochastic Models for Wireless Networks, Paderborn, Germany, 2012.
- C53. R. Couillet, E. Zio, “A subspace approach to fault diagnostics in large power systems” (Invited Paper) IEEE International Symposium on Communications, Control, and Signal Processing (ISCCSP’12), Rome, Italy, 2012.
- C54. A. Kammoun, M. Kharouf, R. Couillet, J. Najim, M. Debbah, “On the fluctuations of the SINR at the output of the Wiener filter for non centered channels: the non Gaussian case,” IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’12), Kyoto, Japan, 2012.
- C55. R. Couillet, P. Bianchi, J. Jakubowicz, “Decentralized convex stochastic optimization with few constraints in large networks,” IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP’11), San Juan, Puerto Rico, 2011.
- C56. R. Couillet, S. Medina Perlaza, H. Tembine, M. Debbah, “A mean field game analysis of electric vehicles in the smart grid,” IEEE International Conference on Computer Communications (INFOCOM’12), Orlando, FL, USA, 2012.
- C57. J. Hoydis, R. Couillet, M. Debbah, “Asymptotic Analysis of Double-Scattering Channels,” IEEE Asilomar Conference (ASILOMAR’11), Pacific Grove, CA, USA, 2011. **Best student paper award finalist**
- C58. R. Couillet, W. Hachem, “Local Failure Localization in Large Sensor Networks,” IEEE Asilomar Conference on Signals, Systems, and Computers (ASILOMAR’11), Pacific Grove, CA, USA, 2011.
- C59. R. Couillet, M. Guillaud, “Performance of Statistical Inference Methods for the Energy Estimation of Multiple Sources,” (Invited Paper) IEEE Statistical Signal Processing Workshop (SSP’11), Nice, France, 2011.
- C60. A. Kammoun, R. Couillet, J. Najim, M. Debbah, “Performance of fast rate adaptation techniques in interference-limited networks,” IEEE Global Communications Conference (GLOBECOM’11), Houston, TX, USA, 2011.
- C61. J. Yao, R. Couillet, J. Najim, E. Moulines, M. Debbah, “CLT for eigen-inference methods in cognitive radios,” IEEE International Conference on Acoustics, Speech and Signal Processing, Prague, Czech Republic, 2011.
- C62. J. Hoydis, R. Couillet, M. Debbah, “Deterministic Equivalents for the Performance Analysis of Isometric Random Precoded Systems,” IEEE International Conference on Communications, Kyoto, Japan, 2011.

- C63. J. Hoydis, J. Najim, R. Couillet, M. Debbah, “Fluctuations of the Mutual Information in Large Distributed Antenna Systems with Colored Noise,” Forty-Eighth Annual Allerton Conference on Communication, Control, and Computing, Allerton, IL, USA, 2010.
- C64. R. Couillet, H. V. Poor, M. Debbah, “Self-organized spectrum sharing in large MIMO multiple-access channels,” IEEE International Symposium on Information Theory, Austin TX, USA, 2010.
- C65. R. Couillet, J. W. Silverstein, M. Debbah, “Eigen-inference for multi-source power estimation,” IEEE International Symposium on Information Theory, Austin TX, USA, 2010.
- C66. S. Wagner, R. Couillet, D. T. M. Slock, M. Debbah, “Optimal Training in Large TDD Multi-user Downlink Systems under Zero-forcing and Regularized Zero-forcing Precoding,” IEEE Global Communication Conference, Miami, 2010.
- C67. S. Wagner, R. Couillet, D. T. M. Slock, M. Debbah, “Large System Analysis of Zero-Forcing Precoding in MISO Broadcast Channels with Limited Feedback” IEEE International Workshop on Signal Processing Advances for Wireless Communications, Marrakech, Morocco, 2010.
- C68. R. Couillet, M. Debbah, “Information theoretic approach to synchronization: the OFDM carrier frequency offset example”, Advanced International Conference on Telecommunications, Barcelona, Spain, 2010.
- C69. R. Couillet, M. Debbah, “Uplink capacity of self-organizing clustered orthogonal CDMA networks in flat fading channels” IEEE Information Theory Workshop Fall’09, Taormina, Sicily, 2009.
- C70. R. Couillet, M. Debbah, J. W. Silverstein, “Asymptotic Capacity of Multi-User MIMO Communications” IEEE Information Theory Workshop Fall’09, Taormina, Sicily, 2009.
- C71. R. Couillet, M. Debbah, J. W. Silverstein, “Rate region of correlated MIMO multiple access channel and broadcast channel” IEEE Workshop on Statistical Signal Processing, Cardiff, Wales, UK, 2009.
- C72. R. Couillet, M. Debbah, “Mathematical foundations of cognitive radios” U.R.S.I.’09, Warsaw, Poland, 2009.
- C73. R. Couillet, M. Debbah, “A maximum entropy approach to OFDM channel estimation”, IEEE International Workshop on Signal Processing Advances for Wireless Communications, Perugia, Italy, 2009.
- C74. R. Couillet, M. Debbah, “Bayesian inference for multiple antenna cognitive receivers”, IEEE Wireless Communications & Networking Conference, Budapest, Hungary, 2009.
- C75. R. Couillet, M. Debbah, “Flexible OFDM schemes for bursty transmissions”, IEEE Wireless Communications & Networking Conference, Budapest, Hungary, 2009.

- C76. R. Couillet, S. Wagner, M. Debbah, “Asymptotic Analysis of Correlated Multi-Antenna Broadcast Channels”, IEEE Wireless Communications & Networking Conference, Budapest, Hungary, 2009.
- C77. R. Couillet, S. Wagner, M. Debbah, A. Silva, “The Space Frontier: Physical Limits of Multiple Antenna Information Transfer”, ValueTools, Inter-Perf Workshop, Athens, Greece, 2008. **Best student paper award**
- C78. R. Couillet, M. Debbah, “Free deconvolution for OFDM multicell SNR detection”, IEEE Personal, Indoor and Mobile Radio Communications Symposium, Cognitive Radio Workshop, Cannes, France, 2008.

LIVRES ET  
CHAPITRES DE  
LIVRES

- **Random Matrix Methods for Wireless Communications** [livre]
 

Outils théoriques des matrices aléatoires (analyse à dimension finie, lois limites, probabilités libres, équivalents déterministes) et applications aux communications mobiles (SU-MIMO, MU-MIMO, CDMA, détection, estimation, modélisation de canal).

  - *Auteurs*: R. Couillet and M. Debbah
  - *Editions*: Cambridge University Press
  - *Année*: 2011
- **Mathematical Foundations for Signal Processing, Communications and Networking** [chapitre de livre]
 

Chapitre “Random matrix theory” sur les matrices aléatoires et plus précisément les méthodes d’inférence statistique.

  - *Auteurs du chapitre*: R. Couillet, M. Debbah
  - *Editions*: CRC Press, Taylor & Francis Group
  - *Année*: 2011
- **Orthogonal Frequency Division Multiple Access Fundamentals and Applications** [chapitre de livre]
 

Chapitre “Fundamentals of OFDMA Synchronization” sur les considérations théoriques et les outils appliqués en synchronisation pour l’OFDM et l’OFDMA.

  - *Auteurs du chapitre*: R. Couillet, M. Debbah
  - *Editions*: Auerbach Publications, CRC Press, Taylor & Francis Group
  - *Année*: 2010

TUTORIAUX

- R. Couillet, H. Tiomoko Ali “Random Matrices for Big Data Signal Processing and Machine Learning”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’17), New Orleans, USA, 2017.
- R. Couillet, “Random Matrices, Robust Estimation, and Applications”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’15), Brisbane, Australia, 2015.
- R. Couillet, A. Kammoun, “Future Random Matrix Tools for Large Dimensional Signal Processing”, European Conference on Signal Processing (EUSIPCO), Lisbon, Portugal, 2014.
- R. Couillet, M. Debbah, “Random Matrix Advances in Signal Processing”, IEEE International Workshop on Signal Processing Advances in Wireless Communications, Darmstadt, Germany, 2013.

- R. Couillet, M. Debbah, “Random Matrix Theory for Signal Processing Applications”, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP’11), Prague, Czech Republic, 2011.
- R. Couillet, M. Debbah, “Random Matrices in Wireless Flexible Networks”, International ICST Conference on Cognitive Radio Oriented Wireless Networks and Communications (Crowncom’10), Cannes, France, 2010.
- R. Couillet, M. Debbah, “Eigen-Inference Statistical methods for Cognitive Radio”, European Wireless, Lucca, Italy, 2010.

## VISITES

**Hong-Kong University of Science and Technology**, Hong-Kong. **Juin 2014**

Collaboration avec le Professeur M. McKay,

- Département Electronic and Computer Engineering
- Sujet: estimation robuste pour les données financières

**North Carolina State University**, Caroline du Nord, Etats-Unis. **Nov. 2009**

Collaboration avec le Professeur J. W. Silverstein,

- Département de Mathématiques
- Sujet: matrices aléatoires pour l’estimation d’énergie de sources multiples

## ORGANISATION DE SESSIONS

*Symposiums et sessions spéciales dans des colloques français et internationaux*

- *International*: Technical Area Chair (IEEE Asilomar, 2016), Session spéciale “Random Matrices in Signal Processing and Machine Learning” (IEEE SSP, 2016), Session spéciale “Random Matrix Advances in Signal Processing” (IEEE SSP, 2014), Session spéciale “Random Matrices and Applications” (IEEE Asilomar, 2013).
- *France*: Journée GdR “Estimation et traitement statistique en grande dimension” (2013).

## PROJETS MAJEURS

*Contribution à des projets français et européens*

- *Europe*: ERC Starting Grant MORE (2012-2017) [co-PI], FP7 NEWCOM# (2012-2015), FET FP7 HIATUS (2012-2015), FP7 NEWCOM++ (2009-2011).
- *France*: ANR RMT4GRAPH (2014-2017) [PI], ANR DIONISOS (2012-2016) [co-PI], ANR SESAME (2008-2012).

## BREVETS

*Brevets détenus par ST-Ericsson*

- R. Couillet, M. Debbah, **No. 08368028.0** “Process and apparatus for performing initial carrier frequency offset in an OFDM communication system”
- R. Couillet, M. Debbah, **No. 08368023.1** “Method for short-time OFDM transmission and apparatus for performing flexible OFDM modulation”
- R. Couillet, S. Wagner, **No. 09368025.4** “Precoding process for a transmitter of a MU-MIMO communication system”
- R. Couillet, **No. 09368030.4** “Process for estimating the channel in an OFDM communication system, and receiver for doing the same”

## THÉSARDS ENCADRÉS

Etudiants (actuels et passés) en thèse sous mon encadrement.

*Lucie Neirac*

**2017-2020**



- encadrée exclusivement par moi-même
- “Réseaux de neurones convolutionnels profonds”
- Soutenance en janvier 2020
- Financement: INSEE

*Zhenyu Liao* **2016-2019**

- co-encadré (80%) avec Y. Chitour
- “Théorie des matrices aléatoires et réseaux de neurones profonds”
- Soutenance en septembre 2019
- Financement: Fondation Supélec

*Xiaoyi Mai* **2016-2019**

- encadrée exclusivement par moi-même
- “Théorie des matrices aléatoires pour l’apprentissage automatique”
- Soutenance en septembre 2019
- Financement: bourse DIGICOSME, Université de ParisSaclay

*Hafiz Tiomoko Ali* **2015-2018**

- encadré exclusivement par moi-même
- “Méthodes de détection de communautés dans les grands graphes aléatoires”
- Soutenance en septembre 2018
- Financement: ANR RMT4GRAPH

*Gil Katz* **2013-2016**

- co-encadré (33%) avec P. Piantanida et M. Debbah
- “Communications interactives pour le calcul distribué”
- Soutenance en septembre 2016
- Financement: ERC MORE

*Azary Abboud (postdoc à l’INRIA)* **2012-2015**

- co-encadrée (50%) avec M. Debbah
- “Optimisation distribuée pour les Smart Grids”
- Soutenance en septembre 2015
- Financement: fondation Supélec

*Julia Vinogradova (postdoc à l’université de Linköping)* **2011-2014**

- co-encadrée (50%) avec W. Hachem
- “Grandes matrices aléatoires, inférence statistique et réseaux de communications mobiles du futur”
- Soutenance en septembre 2014
- Financement: bourse DIGITEO

*Axel Müller (ingénieur de recherche chez HUAWEI)* **2011-2014**

- co-encadré (50%) avec M. Debbah
- “Grandes matrices aléatoires appliquées aux réseaux multi-cellulaires de communications mobiles”
- Soutenance en septembre 2014
- Financement: bourse Intel

## STAGIAIRES

Etudiants stagiaires en master sous mon encadrement.

*Liusha Yang (PhD, HKUST)* **2015**

*Meysam Sadeghi (PhD, NUS)* **2015**

|  |             |
|--|-------------|
| <i>Hafiz Tiomoko Ali (master, CentraleSupélec)</i> | <b>2015</b> |
| <i>Aymeric Thibault (master, CentraleSupélec)</i>  | <b>2015</b> |
| <i>Harry Sevi (master, ENS Cachan)</i>             | <b>2015</b> |
| <i>Adrien Pelletier (master, ENS Cachan)</i>       | <b>2012</b> |

**DIVERS**

*Langues:* Français (langue maternelle), anglais (courant), allemand (scolaire).