

Vivien MARMELAT

Ph.D. - Human Movement Sciences



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French, born on January 10th, 1987

Abstract of research interests

Human movement variability is characterized by the presence of **fractal fluctuations**. This feature is reflective of adaptive, healthy states while non-optimal states, such as ageing and disorders of the central nervous system are associated with a loss of fractal fluctuations toward more periodicity or more randomness. Rhythmic auditory stimulation (RAS) is widely used for gait rehabilitation, but a fixed-tempo metronome alters the fractal fluctuations of stride-time series toward randomness. Recent investigations suggested that synchronization with fractal stimulation could induce a **complexity matching** between the behavioral dynamics and the stimulation dynamics, revealed by the correlation between the fractal exponents of time series.

So far my work focused on investigating **optimal external stimulations** preserving the fractal fluctuations of stride-time series. Different sets of experiments were run during my Ph.D., involving interpersonal coordination, metronome synchronized gait and between-person synchronization of gait ('human pacing'). Overall I showed a complexity matching between the behavioral dynamics of healthy young participants and the stimulation dynamics only when the latter presented fractal fluctuations.

I aim to investigate fractal-tempo RAS with patients suffering of movement disorders, with the perspective to **'re-complexify'** their behavioral dynamics. In addition there is a need to question the relationships between fractal fluctuations and (quantifiable) adaptive behaviors. I would like to further explore the potential relevance of fractal analysis to **detect early changes** in pathological movement dynamics. One of my methodological concerns is to consider the influence of short-term coupling on fractal fluctuations, notably using the detrended cross-correlation analysis.

Recent publications

Marmelat, V., Torre, K., Beek, P.J. & Daffertshofer, A. (2014). Persistent fluctuations in stride intervals under fractal auditory stimulation. *PLoS ONE* 9(3): e91949. doi:10.1371/journal.pone.0091949.

Marmelat, V., Delignières, D., Torre, K., Beek, P.J. & Daffertshofer, A. (2014). 'Human paced' walking: Followers adopt stride time dynamics of leaders. *Neuroscience Letters*, 564, 67-71.

Delignières, D. & Marmelat, V. (2014). Strong anticipation and long-range cross-correlation: Application of Detrended Cross-Correlation Analysis to human behavioral data. *Physica A*, 394, 47-60.

Torre, K., Varlet, M. & Marmelat, V. (2013). Predicting the biological variability of environmental rhythms: Weak or Strong Anticipation for sensorimotor synchronization? *Brain & Cognition*, 83, 342-350.

Position

2014-present	Research associate <i>Movement to Health laboratory – Montpellier-1 University, Montpellier (France)</i>
2011-2014	Research assistant <i>Movement to Health laboratory – Montpellier-1 University</i> <i>Research institute MOVE– VU University Amsterdam, Amsterdam (Netherlands)</i>
2012-2013	Teaching assistant <i>Faculty of Sport Sciences - Montpellier-1 University</i>
2011-2012	Part-time lecturer <i>Faculty of Sport Sciences - Montpellier-1 University</i>
2010	Master’s internship <i>Movement to Health laboratory – Montpellier-1 University</i>

Education

2014	Ph.D. - Human Movement Sciences Synchronization with fractal rhythms: Complexity matching of statistical structure <i>Movement to Health laboratory – Montpellier-1 University, Montpellier (France)</i> <i>Research institute MOVE– VU University Amsterdam, Amsterdam (Netherlands)</i>
2010	M.Sc. - Human Movement Sciences <i>Movement to Health laboratory – Montpellier-1 University, Montpellier (France)</i>
2008	B.S. - Sport Sciences Licence STAPS - Avignon University, Avignon (France)

University & Community service

	Organization committee of scientific conferences
2012	8 th day of the Doctoral School ‘Human Movement Sciences’, Montpellier (France)
2011	International conference of the EC FP6 SKILLS European Project, Montpellier (France)
	Association board member
2012-2014	Secretary - Languedoc-Roussillon League of Rowing (France)
2011-2012	Treasurer - DocSMH Association (PhD students Association of the Doctoral School)
	Steering Committee member
2007-2014	Beaucaire Rowing Club, Beaucaire (France)
2011-2014	Languedoc-Roussillon League of Rowing (France)

Affiliations

2014 International Society for Posture & Gait Research (ISPGR)

Teaching

Fall 2012 Undergraduate courses (96h)

Faculty of Sport Sciences - Montpellier-1 University

Neurosciences – Anatomy - University working methodologies - Psychology & Human sciences - Information technologies

Fall 2011 Undergraduate courses (80h)

Faculty of Sport Sciences - Montpellier-1 University

Neurosciences – Biomechanics – Anatomy – Psychology & Human Sciences - Information technologies

Technical skills

Signal processing

- Recording & computation of time series from human movements
- Production of rhythmic auditory stimulation with non-fixed tempo
- Non-linear analysis of time series

Information technology

- *Experimental devices* Optotrak system, ForceLink C-mill, MobilityLab system
- *Biological signals analysis* Matlab, Scilab
- *Statistical software* Statistica, StatPlus
- *Desktop applications* Adobe Illustrator, Zotero, Microsoft Office, OpenOffice

Languages

- French (native)
- English (fluent)
- Spanish (scholar)

Additional skills

- Reviewer: *Human Movement Sciences*

Personal Interests

Sports

- Rowing: competitor in Beaucaire Rowing Club for 15 years; Club & Local league coach for 5 years
- Running competitor; no competitor sports: fitness, swimming, badminton, football, beach-volley

Readings

- Science-fiction, Fantasy: I. Asimov, P. K. Dick, G.R. Martin, S. King, J. Verne
- Sciences: B. Mandelbrot, T. Kuhn, A. Einstein, J. Gleick, D. Ruelle

Publications

• Peer-Reviewed Articles

- Marmelat, V., Torre, K., Beek, P.J. & Daffertshofer, A. (2014). Persistent fluctuations in stride intervals under fractal auditory stimulation. *PLoS ONE* 9(3): e91949. doi:10.1371/journal.pone.0091949.
- Marmelat, V., Delignières, D., Torre, K., Beek, P.J. & Daffertshofer, A. (2014). 'Human paced' walking: Followers adopt stride time dynamics of leaders. *Neuroscience Letters*, 564, 67-71.
- Delignières, D. & Marmelat, V. (2014). Strong anticipation and long-range cross-correlation: Application of Detrended Cross-Correlation Analysis to human behavioral data. *Physica A*, 394, 47-60.
- Decker, L., Roy, C., Marmelat, V., Torre, K. & Dalla Bella, S. (2014). Optimisation de la stimulation auditive rythmique en vue d'améliorer la rééducation de la fonction locomotrice. Abstract in *Clinical Neurophysiology*, 44(1), 136-137.
- Torre, K., Varlet, M. & Marmelat, V. (2013). Predicting the biological variability of environmental rhythms: Weak or Strong Anticipation for sensorimotor synchronization? *Brain & Cognition*, 83, 342-350.
- Delignières, D. & Marmelat, V. (2013). Degeneracy and long-range correlation. *Chaos*, 23(4), 043109.
- Delignières D. & Marmelat V. (2013). Theoretical and methodological issues in serial correlation analysis. *Advances in Experimental Medicine and Biology*, 782, 127-148.
- Delignières, D. & Marmelat, V. (2012). Fractal fluctuations and complexity: Current debates and future challenges. *Critical Reviews in Biomedical Engineering*, 40(6), 485-500.
- Marmelat, V. & Delignières, D. (2012). Strong anticipation: complexity matching in interpersonal coordination. *Experimental Brain Research*, 222, 137-148.
- Marmelat, V. & Delignières, D. (2012). Relative roughness: An index for testing the suitability of the monofractal model. *Frontiers in Physiology/ Fractal Physiology*, 3, 208. doi: 10.3389/fphys.2012.00208.
- Marmelat, V. & Delignières, D. (2011). Complexity, coordination, and health: avoiding pitfalls and erroneous interpretations in fractal analyses. *Medicina (Kaunas)*, 47(7), 393-398.

In Press

Bousquet, J., Blain, H., Abecassis, H., Adnet, P.A., Alomène, B., Amouyal, M., Bardy, B., Battesti, M.P., Baptista, G., Bernard, P.L., Berthe, J., Boubakri, C., Burille, J., Calmels, M.V., Combe, B., Delignières, D., Dupeyron, A., Dupeyron, A., Engberink, O., Gressard, F., Hève, D., Jakovenko, D., Jeandel, C., Lapierre, L., Léglise, M.S., Laffont, I., Laurent, C., Lognos, B., Lussert, J.M., Mandrick, K., Marmelat, V., Martin-Gousset, P., Matheron, A., Mercier, G., Meunier, C., Morel, J., Ninot, G., Nouvel, F., Ortiz, J.P., Padelou, M.P., Pastor, E., Pélissier, J.Y., Perrey, S., Picot, M.C., Pinto, N., Ramdani, S., Radier-Pontal, F., Royère, E., Rédini-Martinez, I., Robine, J.M., Roux, E., Savy, J.L., Stephan, Y., Strubel, D., Tallon, G., Torre, K., Verdier, J.M., Vergotte, G., Viollet, E., Albinet, C., Ankri, J., Annweiler, C., Benetos, A., Beauchet, O., Berrut, B., Dargent, P., Decker, L., Hanon, O., Joël, M.E., Nourashemi, F., Puisieux, F., Rolland, Y., Ruault, G., Vellas, B., Vuillemin, A., Becker, C., Holand, N., Michel, J.P., Strandberg, T., Bedbrook, A., Granier, S., Camuzat, T., Bourret, R., Best, N., Jonquet, O., de la Coussaye, J.E., Mercier, J., Noguès, M., Aoustin, M., Domy, P., Bringer, J., Augé, P., & Bourquin, C. Living Lab Falls-MACVIA-LR: The falls prevention initiative of the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) in Languedoc-Roussillon. *European Geriatric Medicine*.

Submitted

Marmelat, V., Daffertshofer, A., Beek, P.J. & Delignières, D. Isochronous versus non-isochronous pacing of gait: continuous coupling versus discrete error correction.

- **Books**

Marmelat, V. (2014). Synchronization with fractal rhythms: Complexity matching of statistical structure. *Doctoral thesis*, Ede: GVO printers & designers B.V.

- **Book Chapters**

Delignières, D. & Marmelat, V. (2012). Theoretical and methodological issues in serial correlation analysis. in M. Riley, K. Schockley & M. Richardson (eds.), *Progress in Motor Control: Neural, Computational and Dynamic Approaches*. New York, NY: Springer.

- **Invited Colloquia**

Marmelat, V. (2013, February). Synchronization between complex systems: matching of fractal exponents suggests strong anticipation processes. *Invited lecture at the Department of Psychology, Faculty of Behavioural and Social Sciences*, University of Groningen, Groningen, Netherlands.

Daffertshofer, A. & Marmelat, V. (2013, September). Long-range correlations in temporal sequences – Designing auditory cues for locomotion. Invited speaker talk at *14th Rhythm Production and Perception Workshop*, University of Birmingham, Birmingham (England).

- **Invited Symposia**

Marmelat, V. (2014, October). Complexity matching in acoustically-paced treadmill walking: Perspectives for rehabilitation. 'Auditory-motor synchronization' Symposium at *4th International Congress on Complex Systems in Sports and Healthy Ageing (ICSS & HA)*, Groningen (Netherlands).

Marmelat, V., Torre, K., Daffertshofer, A., Beek, P.J. & Delignières, D. (2013, July). Preservation of fractal gait dynamics using non-isochronous metronomes. 'Variability and fractality' Symposium at *the 17th International Conference on Perception and Action (ICPA)*, Estoril (Portugal).

- **Oral Communications**

Marmelat, V., Torre, K., Daffertshofer, A., Delignières, D. & Beek, P. (2013, May). Synchronization with fractal metronome in walking. *9th Annual Day of the Ecole Doctorale 'Sciences du Mouvement Humain'*, Montpellier (France).

Marmelat, V. & Delignières, D. (2011, October). Strong anticipation: complexities matching during interpersonal coordination. *14th Congress of Sports and Physical Activities Researchers Association (ACAPS)*, Rennes (France).

Delignières, D., Marmelat, V. & Torre, K. (2011, July). Theoretical and methodological issues in serial correlation analysis. *Progress in Motor Control VIII*, Cincinnati (U.S.A.).

- **Posters Presentations**

Delignières, D. & Marmelat, V. (2013). Complexity, degeneracy and long-range correlations. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).

Delignières, D. & Marmelat, V. (2013). Detrended Cross-Correlation Analysis: simulation studies. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).

Delignières, D. & Marmelat, V. (2013). Coordination processes and Detrended Cross-Correlation Analysis. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).

Marmelat, V., Torre, K., Delignières, D., Daffertshofer, A. & Beek, P.J. (2013, June). 1/f cueing vs isochronous cueing: two different dynamics of stride intervals. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).

Delignières, D. & Marmelat, V., Sallagoïty, I. & Mottet, D. (2013). Degeneracy, long-range correlations and accuracy constraints. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).

- Delignières, D. & Marmelat, V. (2013). Bimanual coordination, inter-personal coordination, and time scales. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).
- Marmelat, V., Torre, K., Delignières, D., Daffertshofer, A. & Beek, P.J. (2013, June). 1/f cueing vs isochronous cueing: two different dynamics of stride intervals. *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).
- Decker, L.M., Roy, C., Marmelat, V., Torre, K., Ramdani, S. & Dalla Bella, S. (2013, June). Seeking an optimality criterion for gait improvement via rhythmic auditory stimulation (RAS): A matter of perception? *Inaugural Conference of the Euromov Centre (Montpellier-1 University), Health in Motion*, Montpellier (France).
- Marmelat, V., Daffertshofer, A., Beek, P.J. & Delignières, D. (2012, June). Influence of Hurst exponent of different auditory signals on temporal structure of inter-stride intervals. *8th Annual Day of the Ecole Doctorale 'Sciences du Mouvement Humain'*, Montpellier (France).
- Marmelat, V. & Delignières, D. (2011, December). Strong anticipation: Complexity matching in interpersonal coordination. *International conference of the SKILLS European Project*, Montpellier (France).
- Delignières, D., Marmelat, V. & Torre, K. (2011, December). Degeneracy and long-range correlation: A simulation study. *International conference of the SKILLS European Project*, Montpellier (France).
- Delignières, D., Marmelat, V. & Torre, K. (2010, May). Examples of interpretations for 1/f noise in human behaviour. *6th Annual Day of the Ecole Doctorale 'Sciences du Mouvement Humain'*, Montpellier (France).

References

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