Stochastic averaging for functional diffusions

Fuke Wu[1] and **George Yin**[2]

[1] *School of Mathematics and Statistics, Huazhong University of Science and Technology, Wuhan, Hubei, 430074, P.R. China (e-mail: wufuke@hust.edu.cn)*
[2] *Department of Mathematics, Wayne State University, Detroit, MI 48202, USA (e-mail: gyin@math.wayne.edu)*

Motivated by a wide range of applications from ecology, chemical processes, and queueing next works among others, in this talk, we consider a class of functional stochastic differential equations with two-time scales. The problem may be considered as a singularly perturbed systems, which is highlighted by the use of both slow varying functional stochastic differential equations and a fast varying diffusions. Under broad conditions, we obtain martingale averaging of the systems.

[1] Bao J., Yin G., Yuan C., *Asymptotic Analysis for Functional Stochastic Dierential Equations*, Springer-Briefs in Mathematics, Springer, 2016, xvi+151pp.

[2] Cont R., Fournié D.-A., Functional Itô calculus and stochastic integral representation of martingales, *Annals of Probability* **41**(1):109-133, 2013.

[3] Dupire B., Functional Itô's Calculus, *Bloomberg Portfolio Research Paper*, 2009-04-FRONTIERS. Available at SSRN: http://ssrn.com/abstract=1435551 or http://dx.doi.org/10.2139/ssrn.1435551.

[4] Wu F., Yin G., Wang L. Y., Stability of a pure random delay system with two-time-scale Markovian switching, *Journal of Differential Equations* **253**:878–905, 2012.

[5] Wu F., Yin G., Wang L. Y., Moment exponential stability of random delay systems with two-time-scale Markovian switching, *Nonlinear Analysis Series B: Real World Applications* **13**:2476–2490, 2012.

[6] Wu F., Yin G., Environmental noise impact on regularity and extinction of population systems with infinite delay, *Journal of Mathematical Analysis and Applications* **396**:772–785, 2012.

[7] Wu F., Tian T., Rawlings J., Yin G., Approximate methods for stochastic chemical kinetics with two-time scales by chemical Langevin equations, *The Journal of Chemical Physics* **144**:174112-1–174112-14, 2016.

[8] Mei H., Yin G., Wu F., Properties of stochastic integro-differential equations with infinite delay: Regularity, ergodicity, weak sense Fokker-Planck equations, *Stochastic Processes and Their Applications* **126**:3102–3123, 2016.

[9] Wu F., Yin G., Mei H., Stochastic functional differential equations with infinite delay: Existence and uniqueness of solutions, solution maps, Markov properties, and ergodicity, *Journal of Differential Equations* **262**:1226–1252, 2017.