Theoretical and numerical methods in nonlinear analysis with real-world applications
Méthodes théoriques et numériques en analyse non linéaire avec des applications dans le monde réel
(Org: **Fabrice Colin** and/et **Albert Nina Sandjo** (Laurentian))

JEAN-MARC BELLEY, Université de Sherbrooke
Anti-periodic solutions of Abel equations with state dependent discontinuities

Given $T > 0$, we study Abel's generalized equation $\theta' = f_0 + \sum_{j\in\mathbb{N}} f_j \theta^j$ for θ and θ' real functions on $[0, T]$ subject to given state dependent discontinuities and each f_j a real function of bounded variation for which $f_j(0) = (-1)^{j+1} f_j(T)$. Under appropriate conditions, this equation is shown to admit a unique solution of bounded variation on $[0, T]$ which is T-anti-periodic in the sense that $\theta(0) = -\theta(T)$. The contraction principle yields a bound for the rate of uniform convergence to the solution of a sequence of iterates.

ARNO BERGER, University of Alberta
Digit distributions in non-linear difference equations

The statistical behaviour of numerical signals recorded from a linear dynamical system is quite simple: Generically, any such signal shows one and only one logarithmic distribution of significant digits a.k.a. Benford's Law. For non-linear systems, the situation naturally is far less clear-cut. Even when the dynamics in question is trivial, determining typical digit distributions may nevertheless be delicate. The talk will discuss a few recent results and (counter-)examples in this regard.

GERDA DE VRIES, University of Alberta
Formation of Animal Groups : The Importance of Communication

We investigate the formation and movement of self-organizing collectives of individuals in homogeneous environments. We review a hyperbolic system of conservation laws based on the assumption that the interactions governing movement depend not only on distance between individuals, but also on whether neighbours move towards or away from the reference individual. The inclusion of direction-dependent communication mechanisms significantly enriches the model behavior; the model exhibits classical patterns such as stationary pulses and traveling trains, but also novel patterns such as zigzag pulses, breathers, and feathers. The same enrichment of model behavior is observed when we include direction-dependent communication mechanisms in individual-based models.

MARLÈNE FRIGON, Université de Montréal
Existence results for initial value problems of first-order systems of Stieltjes differential equations

We present the basic theory of existence and uniqueness of solutions for systems of differential equations with the usual derivative replaced by a Stieltjes derivative. This derivative, called g-derivative, was introduced by Lopez Pouso and Rodriguez. The problems that we consider contain as particular cases dynamic equations on time scales and impulsive ordinary differential equations. Our results were obtained in collaboration with Lopez Pouso.

RAHMA GUEN, Université de Sherbrooke
Some averaging results for ordinary differential inclusions

The averaging method was studied for differential inclusions by many authors using different and rather restrictive conditions on the regularity of their right- hand sides. We consider ordinary differential inclusions of the form

$$\dot{x}(t) \in F\left(\frac{t}{\varepsilon}, x(t)\right) \tag{1}$$

where $\varepsilon > 0$ denotes the small perturbation parameter, the time variable $t \in [0, L]$ and F is a multifunction with values that are nonempty compact convex subsets of $\mathbb{R}^d$. We state and discuss some averaging results for these inclusions. Our results are proved under weaker conditions on the regularity of F than found in the literature.

JUNCHENG WEI, University of British Columbia

New Phases in Diblock and Triblock Copolymer Problems

I will discuss the existence and stability of several new phases in the Diblock and triblock copolymers. These include droplets, torus and double bubbles. The analysis involves properties of Green function in large modes and geometric nondegeneracy of perimeter problems.