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In this talk I introduce a simplified version of the classical Krasil'shchik-Vinogradov geometric theory of nonlocal symmetries and present several applications. For example, the theory can be used to find highly non-trivial explicit solutions and Darboux-like transforms to nonlinear equations such as the Kaup-Kupershmidt equation. I also recall the theory of formal integrability and argue that nonlocal symmetries can be used to uncover formally integrable equations. Finally, I present some classifications of nonlocal symmetries of integrable equations which have been recently found, and propose a generalization of the Krasil'shchik-Vinogradov theory.

This talk is partially based on the following papers:

1. E.G. Reyes, Geometric integrability of the Camassa-Holm equation. *Letters in Mathematical Physics* 59 (2002), 117–131.
2. E.G. Reyes, Nonlocal symmetries and the Kaup-Kupershmidt equation. *Journal of Mathematical Physics* 46 (2005), 073507 (19 pages).
3. P. Gorka and E.G. Reyes, The modified Camassa-Holm equation. *International Mathematics Research Notices* (2011) Vol. 2011, 2617–2649.
4. R. Hernandez-Heredero and E.G. Reyes, Geometric integrability of the Camassa-Holm equation II. *International Mathematics Research Notices* (2012) Vol. 2012, 3089–3125.
5. E.G. Reyes, Jet bundles, symmetries, Darboux transforms. *Contemporary Mathematics* 563 (2012), 137–164.
6. P. Gorka and E.G. Reyes, The modified Hunter-Saxton equation. *Journal of Geometry and Physics* 62 (2012), 1793–1809.
7. P.M. Bies, P. Gorka and E.G. Reyes, The dual modified KdV–Fokas–Qiao equation: geometry and local analysis. *Journal of Mathematical Physics* 53 (2012), 073710.
8. R. Hernandez-Heredero and E.G. Reyes, Nonlocal symmetries, compacton equations, and integrability. *International Journal of Geometric Methods in Modern Physics* 10 (2013), 1350046 [24 pages].
9. I.S. Krasil'shchik and A.M. Vinogradov, Nonlocal trends in the geometry of differential equations: Symmetries, conservation laws and Backlund transformations. *Acta Appl. Math.* 15 (1989), 161–209.