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## Explicit solutions to nonlinear partial differential equations via nonlocal symmetries\*

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### Abstract

In this talk I review some recent work on the theory and application of nonlocal symmetries of nonlinear PDEs. This theory was originally developed by A. Vinogradov and J. Kasil'shchik in the 1980's and 1990's as a chapter of their formal theory of differential equations. I would like to show how this theory can be implemented in such a way as to make its application straightforward and useful for applied and numerical mathematics. As examples, I present non-trivial explicit solutions (which could be used to test numerical methods) to the Kaup-Kupershmidt equation

$$q_t = q_{xxxxx} + 5q q_{xxx} + \frac{25}{2} q_x q_{xx} + 5q^2 q_x \quad (1)$$

and also a Darboux transformation for the important Camassa-Holm equation

$$2u_x u_{xx} + u u_{xxx} = u_t - u_{xxt} + 3u_x u. \quad (2)$$

## References

- [1] HERNANDEZ-HEREDERO, R., REYES, E.G., *Remarks on the geometric integrability of the Camassa-Holm equation*. Submitted, October 2008.
- [2] REYES, E.G., SANCHEZ, G., *Explicit solutions to the Kaup-Kupershmidt equation via nonlocal symmetries*. International Journal of Bifurcation and Chaos 17, 2749– 2763, (2007).
- [3] REYES, E.G., *Nonlocal symmetries and the Kaup-Kupershmidt equation*. Journal of Mathematical Physics 46 no. 7, 073507, 19 pp., (2005).

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