İSTANBUL ANALYSIS SEMINARS

A CAUCHY PROBLEM FOR SOME NONLOCAL AND NONLINEAR EQUATIONS

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Abstract: This talk will summarize some recent work done in collaboration with Ceni Babaoğlu (İTÜ), Gülçin Muslu (İTÜ), Nilay Duruk (Sabancı U.), Saadet Erbay, and Hüsnü A. Erbay (Özyeğin U.). We look at non-local, nonlinear wave type equations that arise in elasticity. We consider the Cauchy (initial value) problem and prove local well-posedness and obtain conditions for global existence and finite time blow-up. Typically in one dimension we consider the following types of integro-differential equations

$$u_{tt} = (\beta * (u + g(u)))_{xx} \qquad x \in \mathbb{R},\ t > 0,$$
$$u_{tt} + Lu = u_{xx} + g(u)_{xx} \qquad x \in \mathbb{R},\ t > 0,$$

where $*$ denotes the convolution, β is some integrable function whose Fourier transform satisfies a growth condition of the form

$$0 \leqslant \widehat{\beta}(\xi) \leqslant C\,(1 + \xi^2)^{-r/2},$$

and L is some constant coefficient pseudodifferential operator and g is a general nonlinear term. For certain choices of the operator L and kernel β, the problem reduces to the well investigated Boussinesq type equations.

Similar investigations also apply to the *peridynamic problem*

$$u_{tt} = \int \alpha(x - y) g(u(y) - u(x))\, dy \qquad x \in \mathbb{R},\ t > 0,$$

where again α is some integrable function.

In all these problems, the convolution type term has a certain regularizing effect counterbalancing the effect of the nonlinearity.

***Date*:** February 17, 2012
***Time*:** 15:40
***Place*:** Sabancı University, Karaköy Communication Center
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