CRC 1173: Workshop of Projects A5 & A6
Nonlinear Maxwell Equations
January 15, 2016, 14:00–18:00

Schedule

All talks take place in room 3.060

14:00 – 14:45	Martin Spitz	*Local wellposedness of a class of nonlinear Maxwell equations*
14:50 – 15:20	Roland Schnaubelt	*On blow-up for the Kerr-Maxwell system and on a related class of retarded nonlinear problems*
15:25 – 15:55	Coffee Break	
15:55 – 16:40	Piotr Idzik	*Existence of travelling waves for certain quasilinear/semilinear wave equations*
16:45 – 17:30	Andreas Hirsch	*Nondegeneracy of a nonlinear curl-curl equation and related problems*
17:35 – 18:05	Wolfgang Reichel	*Breathers for a class of semilinear curl-curl wave equations*

Everybody is welcome.

After the talks we suggest to have dinner at the restaurant Caminetto.

Local wellposedness of a class of nonlinear Maxwell equations

Martin Spitz

In this talk we study the nonlinear Maxwell equations with instantaneous material laws on the half space with a perfectly conducting boundary. The equations may include currents, charges, and conductivity. A local wellposedness theorem in H^3 and the strategy for its proof are presented. We explain the key steps of this proof and also address the main difficulties therein.

On blow-up for the Kerr-Maxwell system and on a related class of retarded nonlinear problems

Roland Schnaubelt

We present a (not quite completed) construction for solutions to the Kerr-Maxwell system in $\mathbb{R}^3$ such that the curls of the fields blow up in L^2 and whose initial fields are divergence-free test functions. In a second part we discuss energy estimates for a general class of nonlinear retarded problems which are similar to Maxwell systems with a Kerr nonlinearity that is nonlocal in time.

Existence of travelling waves for certain quasilinear/semilinear wave equations

Piotr Idzik

During the talk we will discuss the problem of existence of travelling waves for a quasilinear equation

$$\nabla \times \nabla \times \overrightarrow{E} + \mu \partial_t^2 \left(\epsilon_r(x) \, \overrightarrow{E} + \left| \overrightarrow{E} \right|^2 \overrightarrow{E} \right) = 0,$$

and for a semilinear equation

$$\nabla \times \nabla \times \overrightarrow{E} + \mu \epsilon_r(x) \, \partial_t^2 \overrightarrow{E} + \Gamma(x) \left| \overrightarrow{E} \right|^2 \overrightarrow{E} = 0.$$

Nondegeneracy of a nonlinear curl-curl equation and related problems

Andreas Hirsch

In this talk we consider the nonlinear curl-curl equation

$$\nabla \times \nabla \times U + \lambda U = |U|^{p-1} U \tag{1}$$

for $U\colon \mathbb{R}^3 \to \mathbb{R}^3, U \in H^1(\mathbb{R}^3)^3, \lambda > 0$ and $1 < p < 5$.

We will introduce a cylindrical setting in which (1) reduces to a scalar cylindrical Schrödinger-type equation of the form

$$-\Delta u + \lambda u = r^{p-1} u^p \text{ in } \mathbb{R}^5, \tag{2}$$

where $r = \sqrt{x_1^2 + x_2^2 + x_3^2 + x_4^2}$ and $u = u(r, x_5)$. The main-issue will be to prove nondegeneracy of ground states of (2) in a space which possesses some additional symmetry in x_5-direction.

Finally, we sketch problems which arise naturally if one tries to extend the nondegeneracy result to a wider class of functions.

Breathers for a class of semilinear curl-curl wave equations

Wolfgang Reichel

(joint work with Michael Plum)

We consider so-called breathers, i.e., spatially localized $\mathbb{R}^3$-valued time-periodic solutions of the semilinear problem

$$s(x)\partial_t^2 U + \nabla \times \nabla \times U + q(x)U \pm V(x)|U|^{p-1}U = 0 \text{ on } \mathbb{R}^3 \times \mathbb{R}.$$

Under suitable conditions on the coefficients $s, q, V : \mathbb{R}^3 \to \mathbb{R}$ and the exponent $p > 1$ we prove the existence of breathers by a partly explicit construction based on a simple phase-plane argument.