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Existence and Uniqueness of Solutions for a Nonlinear Fractional Elliptic System

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Abstract

In this article, we study the existence and uniqueness of weak solution for the non-linear fractional elliptic system

$$\begin{cases} (-\Delta)^s \varphi(z) = p(z, \varphi(z), \phi(z)) & \text{in} \quad \Omega, \\ (-\Delta)^s \phi(z) = k(z, \varphi(z), \phi(z)) & \text{in} \quad \Omega, \\ \varphi = \phi = 0 & \text{on} \quad \mathbb{R}^n \setminus \Omega, \end{cases}$$

with $s \in (0, 1)$ and Ω is an open bounded subset of $\mathbb{R}^n$. We use the Schauder fixed point theorem to prove the existence of solution under suitable assumptions on the nonlinearities p and k, and the contraction principle to prove the existence and uniqueness of solution in a particular case.

Keywords: nonlinear elliptic equations; fractional Laplacian; weak solution.