Existence results for implicit fractional differential equations with nonlocal boundary conditions

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We discuss the existence of solutions to the implicit fractional differential equation

$$^{c}D^{\alpha}u = f\left(t, u, u', {}^{c}D^{\beta}u, {}^{c}D^{\alpha}u\right)$$

satisfying the nonlocal boundary conditions $u(0) = u(T)$, $\phi(u) = 0$. Here, $\alpha \in (1, 2]$, $\beta \in (1, \alpha)$, $f \in C([0, T] \times \mathbb{R}^4)$, $\phi : C[0, T] \to \mathbb{R}$ is a (generally nonlinear) functional and ^{c}D is the Caputo fractional derivative. Existence results are proved by the Leray-Schauder degree method.