Young researcher PhD position in the field of identification of fractional order systems

We are offering a Young Researcher (MR) position in the field of identification of fractional order systems.

Location: Jožef Stefan Institute, Department of Systems and Control `http:\dsc.ijs.si`

We are looking for qualified and talented enthusiast PhD students who wish to investigate modelling problem of fractional order systems.

Background

Fractional-order models serve to characterise a wide variety of dynamic processes, including protein movements on cell membranes, bacterial motion, transportation on social networks, NMR diffusometry, transport in semiconductors, migration etc. All these processes share a common property: memory, or in other words, hereditary information. This basically means that the system's future dynamics depends on the way the system was "treated" throughout its lifetime. While the use of FOSs is mostly an empirical tool, mathematically, such fractional or non-integer derivatives may in fact arise from the solution of parabolic partial differential equations. The project goal is to employ FOS models for examining the behaviour of electrochemical energy systems (fuel cells and batteries).

Based on the Laplace transform of an integer-order derivative of a function $f(t)$ with zero initial conditions, i.e.

$$s^p F(s) \quad \rightarrow \quad \frac{d^p f(t)}{dt^p}, \qquad p \in \mathbb{N}, \tag{1}$$

it seems quite natural to allow for $p \in \mathbb{R}^+$ in the Laplace domain. In fact, in the time domain, the Riemann-Liouville fractional derivative ${}_aD_t^p$ of order $p \in \mathbb{R}^+$ is defined as the k-th derivative of a fractional integral, where $k-1 \leq p < k$:

$${}_aD_t^p f(t) = \frac{1}{\Gamma(k-p)} \frac{d^k}{dt^k} \int_a^t (t-\tau)^{k-p-1} f(\tau) d\tau, \ p > 0, \ k-1 \leq p < k. \tag{2}$$

Therein, Γ is the Gamma function generalizing the factorial to positive real numbers.

Objective of the proposed research

- to develop methodology for time-domain identification of fractional-order systems
- to resolve issues regarding identification of stiff FOSs such as electrochemical energy systems
- to propose a solution for performing structural identification of FOS

Required qualifications/competences

- A master's degree in computer science/engineering, applied mathematics, control theory, electrical engineering, mechanical engineering, aerospace engineering, mechatronics, physics, or other related disciplines
- Excellent verbal and writing skills in English with very good communication skills
- Well-developed programming skills - preferably Python

Application

To apply for this Ph.D. position, send an email to pavle.boskoski@ijs.si with "PhD application" as subject, attaching an academic CV, a cover letter, a pdf of your diplomas and transcript of course work and grades, a certificate of proficiency in English, and any other document deemed necessary by the candidate which can enrich the application. The call for applications will remain open until the optimal candidate is found.