

**Department of Computational and Data Sciences
Indian Institute of Science
Bangalore - 560012**

Advertisement No: CDS/DS/MHRD-STARS/Jan-2020/RA

Date: 21/01/2020

Advertisement for Post-doctoral Fellow Positions

Indian Institute of Science (IISc) now seeks to recruit post-doctoral fellows (called as Research associates (RA) as per IISc norms).

Specific Roles & Responsibilities: The primary task will include the following.

- Derivation of numerical schemes to solve stochastic partial differential equations using finite element method.
- Implementation of the above schemes in C++ with OpenMP/MPI/CUDA for deployment in distributed computing platforms.
- Applying the above software to solve fluids, energy, and/or structures related problems.
- Presenting results and writing journal papers.

Essential Qualifications:

- Ph.D. in a computational field with undergraduate degree in Mechanical, Aerospace, Chemical, Civil, Electrical, Mathematics and Computing, Computational and Data Sciences or equivalent.
- Deep expertise in C++ (For e.g., must have written at least 5000 lines in any OOP language such as C++, JAVA; must have compiled and linked several classes and routines to create executable; must have used own code to solve engineering problems).
- Experience in OpenMP/MPI/CUDA-based parallel applications is desired.
- Experience in Finite Element Methods is desired.
- Published at-least one paper where the candidate completed at least 80% of the work including writing.

In all cases, strong background in Linux, operating system concepts and programming are required. The candidate is expected to have good communication skills (speaking and writing) and should be willing to work in a team environment.

The candidate should have secured at least a first-class degree.

Salary: Rs. 38,000-50,000 p.m. (Depending on experience; as per IISc Norms)

Terms of Appointment: This is a contract appointment, initially for one year and renewable thereafter based on an annual evaluation of performance.

How to Apply: Interested candidates may send their resume (preferably in pdf format, with subject marked Advertisement No. CDS/DS/MHRD-STARS/Jan-2020/RA) by email to: deepakns@iisc.ac.in. In the resume, please also include a link to your google scholar page, webpage with information to access your papers, codes and reports. Also share your coding experience as a git repository. Also provide evidence to meeting the essential qualifications listed above.

Programming Task: Complete the Heat Diffusion and Monte Carlo Simulation programming tasks in the next page.

Last date for application: February 15, 2020.

Contact Details:

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Programming Tasks

Heat Diffusion

Solve the unsteady heat diffusion equation on a square domain $[0,1] \times [0,1]$ with an initial temperature distribution $T(t=0, x, y) = \{40 \text{ C, if } (x-0.5)^2 + (y-0.5)^2 < 0.2; 20 \text{ C otherwise}\}$. The boundaries are maintained at 20 C all the time.

First choose a discretization scheme (FD or FV or FE) and write the discrete heat equation. In case of FD, identify the order of the scheme, FV identify the control volume and for if using FE, write the weak form.

Thereafter code the above in C++, compile and plot the transient response at time $t=5s, 20s, 50s$ and $7200s$.

Please include the code, input files, output images in your git repository. Prepare a report (of max 1.5 pages, 11pt font, 1-inch margin, in latex) with the results.

Monte Carlo Simulation

Consider the set of coupled ODEs:

$$\frac{dx}{dt} = 10(y - x)$$

$$\frac{dy}{dt} = x(28 - z) - y$$

$$\frac{dz}{dt} = xy - \frac{8}{3}z$$

$$x(0) = y(0) = z(0) = 1$$

Write an explicit RK-4 scheme to solve the above coupled system.

Now consider that the initial condition is not exactly known – it is only known that the initial value of (x,y,z) is a joint Gaussian with mean $(1,1,1)$ and covariance of identity matrix. Sample 10,000 elements from this joint PDF and simulate the above coupled ODEs with each of those initial conditions. Plot the pairwise joint PDF of (x,y,z) at a few timesteps and explain your findings.

Please include the code, input files, output images in your git repository. Prepare a report (of max 1.5 pages, 11pt font, 1-inch margin, in latex) with the results.

You may use MATLAB, Python, or C++ to solve the above problem.