Report on research visit of Prof. Kailash C. Patidar

[University of Missouri - University of the Western Cape -- Academic Exchange Program for 2024]

I visited the Missouri Science & Technology University in Rolla during 24 November – 23 December 2024. I was hosted by Prof. Martin Bohner from the Department of Mathematics and Statistics at MST. This report answers the following questions:

i. What were the objectives of your visit?

The main objective of this visit was to make progress on on-going collaborative work with my host, in particular, the exploration of time-scales methodology for singularly perturbed problems. For this, the first objective was to conduct some numerical studies and identify possible synergies of these techniques to solve problems in Mathematical Biology. The second objective was to identify singularly perturbed problems for which the time-scales approach could be applied.

ii. If your objectives were fulfilled, to what do you attribute your success? If not, what were the reasons?

We were successful in obtaining time-scales results for a Susceptible-Infectious-Susceptible model and for a HIV model with two-subtypes. We then extended this approach to solve a co-infection model of HIV-TB and obtained reliable results. The results that we obtained for some special cases were similar or better than those that we obtained by using non-standard finite difference methods for similar problems. The later part of my visit was focused on discussions around typical singularly perturbed systems which involve a small parameter associated with the highest derivative term in the differential equation (or equations in the case of systems). Over the years, these equations have been treated by several numerical techniques, of which, the most popular ones were the fitted numerical methods. We wished to explore ways in which we can obtain comparative or better results with lesser efforts.

iii. If you could change any aspect of your visit, what would it have been?

This visit was one of the most productive visits that I had through this UM-UWC collaboration and I did not find anything that needed to be changed for now.

iv. How could the planning and preparation for your visit have been improved by UWC?

Over the years, this program has improved its operations and I did not experience any challenges. While UWC did the necessary processing of my application, the Missouri team was

actively engaged on relevant matters from the beginning thus made my travel and stay very comfortable.

v. What is your overall assessment of the value of the UM / UWC Exchange Program?

From my own experience and my conversations with the staff who travelled to USA through this program, I gathered that it gives researchers a very good platform to begin new collaborations or strengthen their existing research niches.

vi. If you could change any aspect of the exchange program, what would it be?

Over the years, it has improved significantly, and hence, I did not find anything that needs to be changed.

vii. Did you encounter any notable problems during your visit?

No.

viii. How will your visit contribute to strengthening and improving programs at UWC?

The purpose of this visit was to explore methods based on time-scales analysis to solve differential equations and their systems. This is something new to UWC and would therefore contribute to the strengthening of the Applied Mathematics research field at UWC. Once the post-graduate programme in UWC's Mathematics Department is more stable, there is a possibility of introducing a short course on time-scales theory and its applications at honours level.

ix. Given the opportunity to participate in the exchange again, would you do so?

Yes, definitely. Apart from focusing on the problems as posed in the proposal, we identified several other problems that could be addressed in the future.

x. What, if anything, about your exchange experience surprised you?

It was a standard collaborative research visit but the surprising part was the rejuvenating experience of a face-to-face interaction after COVID-19.

xi. What did you like most about the program?

I thoroughly enjoyed the daily research interactions with my UM host. Since, it is a new area of research for me, it was important to have more face-to-face engagements with my host and it was possible at this time of the year.

xii. What other observations would you like to share?

If the collaboration continues, I would anticipate that the quality as well as quantity of the research outputs at UWC will improve.

xiii. How is the knowledge and experience gained on this exchange program going to influence your future work related endeavors?

As I mentioned earlier, it would strengthen my on-going research in the field of Numerical Analysis and Scientific Computing. The time-scales methodology has some merits over other contemporary methods and hence these methods might be exploited to solve a range of problems in varying contexts.

xiv. What specifically will these future endeavors entail?

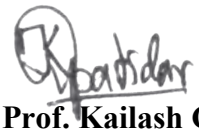
This would entail joint-supervision of post-graduate students at masters and doctoral levels as well as the improvement in the quality of publications. These will contribute to UWC's aspirations to be a research-led university.

xv. Should the exchange program be continued? If so, why?

Yes, definitely. There are many challenging research problems which can be well-addressed/resolved through such collaborative exchanges.

In summary, my research visit to MST was scientifically very beneficial and it will have long lasting impact on my on-going research. We have obtained some good computational results for three mathematical models as stated earlier and now we are busy finalising theoretical framework after which one paper will be submitted to a prestigious international journal. The intended submission is in March 2025.

Finally, I would like to thank my host Prof. M. Bohner for hosting me at MST and having many fruitful discussions. I am also grateful to Prof. R. Uphoff (Director, UMSAEP), Prof. J. Frantz (DVC Research & Innovation, UWC), Mr. U. Bawa (Director, International Relations Office, UWC), and other UM-UWC staff for facilitating my trip to MST.



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