Report on UM-UWC research visit of Prof KC Patidar

Campus visited: University of Missouri, Kansas-City

Host: Dr Xianping Li

Visit duration: 20 June 2019 - 12 July 2019

This report is based on the questionnaire in the UM-UWC exchange application form 2019. As part of this exchange program, I visited the University of Missouri at Kansas-City during 20 June 2019 - 12 July 2019. The report answers the following questions:

i. What were the objectives of your visit?

The main aim of this visit was to continue our joint work on design, analysis and simulation of fitted finite element methods for solving problems in image processing and Mathematical Biology. In view of the 2018 visit of Dr Xianping Li at UWC (as part of this exchange program), the applicant and Dr Li have constructed basic framework for fitted methods that can be applied to problems in image processing and Mathematical Biology. The objective of this 2019 UMKC visit was therefore to prepare a sound manuscript on this subject and to come up with at least one manuscript which deals with the novel methods that can be applied to solve some challenging problems in Population Biology.

ii. To what do you ascribe your success and challenges?

The problem that we wished to solve in a finite element framework was not an easy one. However, several discussions emanated from Dr Li's visit to UWC and on-going e-mail exchanges between him and I have resulted in a success. The challenges for projects like this are that we can only share the main outcomes when we physically meet because careful simulations require discussions on a lot of cross questions that need to be answered before a computational solver can be trusted.

iii. What changes and improvements do you recommend?

When I completed a similar application in 2018, I was not aware of the rule that both UM and UWC collaborators have to alternate their visits. In some sense, this is good but on the other hand, if there are projects which are linked to students' research, this rule may pose as a challenge when the students are about to complete their studies at UWC. Maybe this aspect can be re-looked at (if there is enough evidence, especially in terms of submission of research contributions for publications).

iv. How do you locate the value of the UM / UWC Exchange Program within the goals of your department / faculty and subsequent work?

With several recent initiatives, our Department of Mathematics and Applied Mathematics at UWC has embarked on multidirectional research in Applied Mathematics. One of the research niches that is benefiting from these collaborations is Mathematical Biology. In fact, a lot of work has already started in this field and these visits are advancing our research in this particular direction. My visit to UMKC in 2017 and Dr Li's visit to UWC in 2018 have resulted in numerous discussions which are leading to a number of collaborative projects between the two institutions.

v. How will your visit contribute to strengthening and improving your research / teaching at UWC?

Analysis and simulation of mathematical models in Population Biology is one of the popular research focuses of my research team at UWC. Many of my other colleagues at UWC have also started working in these directions. Often we consider some prototype models which are hard to be solved analytically but we develop a range of reliable approximation methods to solve them. To this end, this particular visit has added a new dimension to my existing approaches whereby we can indeed use a robust finite element approximation method in special direction and combine that with an efficient finite difference method in the time domain. The final outcome of this recent visit has opened the door for many other research problems that we have recently started working on.

In terms of its impact on teaching at UWC, our Department of Mathematics and Applied Mathematics offers some applied math modules at undergraduate and honours levels. Numerous bi-products emanating from our day-to-day discussions from such research visits can be used for some mini-projects that we often give to our second- and third-year students for group discussions, and to our honours students for their 30 credit research projects.

vi. What has been the most rewarding about the program?

It gives a unique opportunity to interact with high profile researchers at two institutions.

vii. What are your future goals, following this mobility?

I wish to make use of the ideas generated through this visit into multiple directions. Depending on the support, I will hope that my future UM collaborators can spend more time in Cape Town to share their knowledge and research findings with our post-graduate students at UWC.

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

Yes, it must definitely continue. It gives plentiful opportunities to discuss the research at a high level. Some of the most challenging research problems are hard to be solved without such long term collaborative visits. The continuation of this program will allow larger research groups to interact for longer periods of time unlike formal communications that usually take place during short visits or international conferences. Such exchange programs are very useful for projects that involve multiple researchers of different scientific expertise.

In summary, this particular visit has been very beneficial for me in terms of the completion of one of my ongoing works with Dr Li. The partial work that started with 2018 visit of Dr Li to UWC involving exploration of robust finite element methods combined with efficient finite difference methods have led to a conclusion in this visit in terms of a brilliant research article. **We have now finalised a full research paper and submitted it to an accredited (by DHET South Africa) journal for possible publication**.

Finally, I would like to thank Dr Xianling Li for hosting me at UMKC. I also wish to thank Prof Uphoff (the UMSAEP program director), Mr Bawa (Director, International Relations Office, UWC), Prof Frantz (DVC Research and Innovation, UWC) and UM-UWC staff for facilitating my trip to UMKC.

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