

Ruth Bowness talks with Mark Alber, Distinguished Professor of Mathematics and Director of the Interdisciplinary Center for Quantitative Modeling in Biology at the University of California Riverside. Mark is also the Chair of the Organizing Committee for SMB2021.

1. Tell us about your research focus:

Multi-scale modelling of Bacterial Swarming and Early Development and Blood Clotting.

2. Who or what inspired you to become a mathematical biologist?

My parents. My father was a mathematician and my mother was a pathologist.

3. What are you currently researching?

Mechanisms of shape and structure tissue and organ formation during development as well as mechanisms of interactions between bacteria and fungi forming a microbiome system.

4. Have you encountered any surprising results in your research?

In order to go forward more efficiently as group, individual bacteria goes backwards. Groups of highly social bacteria maintain order by periodically reversing direction. The model simulations suggest in [1] that reversing direction gives the bacteria information about their neighbours' locations and allows the group to maintain formation, even in the absence of information about the swarm as a whole. Individual cells use a lot of energy for reversals, but still it's beneficial for the whole population. The model showed that swarms expand at the greatest rate when cells reverse direction roughly every eight minutes — matching the timing observed in *M. xanthus*. Over time, the reversals generate a more orderly swarm, with more cells in parallel, making them less likely to bump into one another. <https://www.nature.com/articles/news.2009.43>

Our group has also shown in [2] that blood clot shrinkage occurs when platelets form hand-like protrusions called filopodia. These filopodia then attach to fibrin fibers and reel them in using the same hand-over-hand action used by a person pulling on a rope. We have revealed a novel function for filopodia, which is their ability to re-arrange the fibrin matrix to cause clot shrinkage. This is very different from previously known functions of filopodia. These findings can aid in the design of thrombolytic therapeutics for enhanced treatment of blood disorders, including thrombosis and thromboembolism. <https://www.universityofcalifornia.edu/news/how-blood-clots-shrink-and-why>

5. What is your favourite research paper that you have written?

1. Wu, Y., Jiang, Y., Kaiser, D., and M. Alber [2009], Periodic reversal of direction allows Myxobacteria to swarm, Proc. Natl. Acad. Sci. USA 106 4 1222-1227 (featured in the Nature News, January 20th, 2009, doi:10.1038/news.2009.43, <https://www.nature.com/articles/news.2009.43>).
2. Oleg V. Kim, Rustem I. Litvinov, Mark S. Alber and John W. Weisel [2017], Quantitative Structural Mechanobiology of Platelet-Driven Blood Clot Contraction, Nature Communications 8: 1274. <https://www.nature.com/articles/s41467-017-00885-x.pdf> (authors for correspondence: J.W. Weisel and M. Alber).



6. What do you see as the biggest challenges in your field?

Having impact on both mathematics and biology and medicine. Reaching out and closely collaborating with experimentalists.

7. What advice would you give to a junior mathematical biologist?

I would like to encourage junior mathematical biologist to get trained in variety of mathematical and computational modelling approaches as well as data analysis tools and get exposure to real experiments in a lab.

8. What is the best part of being a mathematical biologist?

Having potential fast impact on lives of people as well as introducing new mathematical problems such as study novel nonlinear diffusion PDEs motivated by math biology.

9. SMB2021 is fast approaching! Can you tell us about your experience organising the meeting?

The experience has been very exciting and stressful since SMB2021 will be run 24h per day. Close collaboration with researchers all over the world including representatives of partner societies, as well as with members of our organizing and scientific committees was most rewarding during this very difficult year. We made a lot of new friends and hope very much that the conference will provide much needed support and recognition for members of our math biology community. Also, focus on promoting Diversity, Equity and Inclusion is very important to us and provided an inspiration for all people working on putting together this exciting meeting.

10. What do you do when you're not working?

Hiking with my family in Southern California.