PHYS498EBP: Paper reading assignment for Fluorescence Microscopy

First, you should also feel free to contact Paul (selvin@illinois.edu), Rohit (rohitmv2@illinois.edu) or Yeoan (yyoun4@illinois.edu). We are available by email, or by Zoom. Our office hours will be posted on the Physics 498EXB. In general, they will be flexible. (Our priority is with YOU, to try and make this a reasonable experience.) Now, on to details of the reading….

Both groups should read the following papers, write a report and prepare an oral presentation according to the following questions. You don't have to limit yourself to these three papers. If you found other resources which can give you better idea, refer to them.

1. Toprak, Erdal, Comert Kural, and Paul R. Selvin. "Super-Accuracy and Super-Resolution: Getting Around the Diffraction Limit." In *Methods in enzymology*, vol. 475, pp. 1-26. Academic Press, 2010.
2. Huang, Bo, Hazen Babcock, and Xiaowei Zhuang. "Breaking the diffraction barrier: super-resolution imaging of cells." *Cell* 143, no. 7 (2010): 1047-1058.
3. Han, Rongcheng, Zhenghong Li, Yanyan Fan, and Yuqiang Jiang. "Recent advances in super-resolution fluorescence imaging and its applications in biology." *Journal of Genetics and Genomics* 40, no. 12 (2013): 583-595.

Format of the report:

Answer the common question and the questions for each group in the written report. Use single spaced, normal margin (1" for all 4 sides), Arial font size 11 or Times font size 12, and do not exceed 10 pages. Diagrams and Pictures are not included in the total length. We recommend discussing with others in your group. However, everyone must prepare and turn in your own report by yourself.

Format of the oral presentation:

The oral presentation is 15 minutes long followed by additional 5 minutes of discussion. Prepare the presentation remotely (via Skype, Zoom, or etc.) Important thing is that we want every group member to participate equally (in terms of effort, presentation time, etc.). In general, each person should plan on 5 minutes of presentation. Sample formats for the presentation are given below. They are given just as an example, feel free to vary it based on your strategy.

All oral presentations should start with the title of the three articles. Every slide has one sentence or phrase of what the general subject is (e.g. Principle of SMLM, Application of SMLM), and then a one sentence or phrase of what the conclusion is (e.g. SMLM technique can achieve xx nm localization accuracy, etc.).

The very last slide (of presenter 3) should have the summary and conclusion slide presented again, so that the other students (and TAs and Professors) who are evaluating you, have the main results staring at them,

1st group
1st person: Introduction to microscopy
2nd person: How SMLM breaks the diffraction limit of light
3rd person: Application of the technique

2nd group
1st person: General overview with emphasizing more of ensemble techniques (e.g. comparison of super-res ensemble vs. SMLM, etc.)
2nd person: Principle and application of STED
3rd person: Principle and application of SIM

Questions for written reports and oral presentation

1. **Common questions for written report**
   1) In Huang et al., there are two categories of super-resolution techniques. What are they? How does each technique achieve super-resolution?
2. **Questions for group 1 (Sara, Nikhila and Sepehr)**
   1) What is the principle of SMLM technique? How do SMLM techniques (FIONA, SHRIMP, SHREC, (d)STORM/(F)PALM) overcome the diffraction limit of light? Also, what is the diffraction limit of light? How does it relate to accuracy and resolution?
   2) How does Total Internal Reflection Fluorescence (TIRF) microscopy help to get super-accuracy?
   3) What advantages and disadvantages do SMLM have over super-resolution ensemble techniques?
   4) Toprak et al. introduces the applications of FIONA. Introduce the applications and technical importance of FIONA to the achievement.
   5) All 3 papers introduce various applications by SMLM. Choose 1 or 2 examples and explain how SMLM contributed to the work. Why did the authors use SMLM and not super-resolution ensemble techniques?
3. **Questions for group 2 (Satwik, Michael and Ali)**
   1) Explain the principle of "STED." How does STED achieve super-resolution? What dis-/advantages does STED have over other super-resolution techniques? What is the diffraction limit of light? How does it relate to accuracy and resolution?
   2) What is the principle of "SIM?" How does SIM achieve super-resolution? What dis-/advantages does SIM have over other super-resolution techniques?
   3) The papers introduce application by super-resolution ensemble techniques (STED or SIM). Choose 1 example for STED and SIM respectively, explain how the technique contributed to the work. Why did the authors use STED/SIM not SMLM?