2016 – BIC Highlights

The keynote speaker at the 15th Annual BIC Research Day in January was Dr. Thomas Yeo of the National University of Singapore, who presented his thoughts on hierarchical Bayesian models of brain function and disorders. Other topics on offer covered the multidisciplinary spectrum of interests in the BIC community, from MRS to TMS to PET. Functional MRI is the mainstay of most BIC users, to be sure, but we can't be accused of modality bias!

Talking of TMS, Daniel finished exhaustive testing of the MagPro TMS unit and determined that its performance is fundamentally limited by use of a capacitor to store the electrical supply to the TMS coil. The switch being used all but guarantees some leakage current despite the leakage blocking upgrade we installed. The upgrade reduces the leakage by an order of magnitude, but that isn't enough to eliminate perturbation of EPI data. Until MagPro re-designs their control hardware, we have gone as far as it is possible to go to improve performance. We are limited to <20 Hz TMS pulses, synchronized to the crusher gradients in the EPI sequence. However, Daniel successfully used the control circuitry developed for the MagPro to improve performance of the TMS units used outside the MRI suite. He built a device to enable triggering of a TMS system from a PC, for more flexible temporal control of the TMS stimulus. In addition, these modifications enable triggering of the Brainsight system for better MRI-based registration of TMS stimulus loci.

Rick revised our subject reception and screening area this year, and purchased a new ferromagnetic detector for Zone III. Subject reception and screening now has a dedicated space in room B100C, the spare 3 T operator room, which is in Zone II. The space includes the old walk-through metal detector and the hand-held wand, as well as lock boxes for valuables. Subjects should be screened fully in the new space, then accompanied to Zone III where the ferromagnetic detector should be used for a last-minute check prior to entry into Zone IV.

Miguel spent considerable time and effort improving BIC's custom 3D printer. He took several online courses to be able to make further tweaks to the various software packages being utilized. The finish of the printed head restraints is now so smooth that removal of rough edges by sanding is no longer required. The failure rate for large print jobs is also way down, with small but critical improvements to the extruder hot end, determining the best material for the base print layer to adhere to, the way substrate is spooled, etc. While our 3D printer isn't open to general use, if you think you have something BIC-related that might be printable, give us a shout.

The NorCal SNUG met twice in 2016, in April and December. The community decided that all the hardware and software upgrades happening around the area warranted a second meeting. These included the Trio to Prisma-fit upgrade at UCSF, and Siemens' decision to move all currently available MRI scanners onto version E11 software from 2017 onwards. No more separate software versions for different scanner platforms, no matter what field strength or magnet bore size. In April, SNUG met at UCSF Mission Bay at a meeting organized by Roland Henry. Topics included MR spectroscopy, spinal cord & high resolution imaging, as well as upgrades and especially VE11 software-related issues. The SNUG met again at UC Davis in December. On the agenda: latest information on hardware and software upgrade issues, and scientific sessions on dynamic imaging and spectroscopy. Rotating the SNUG location gives each site an opportunity to emphasize local research interests, and with the meeting at UC Davis we learned a lot about CSF flow in pediatrics and autism. This year also saw SNUG claim its first success at stimulating new

work, based on discussions held at an earlier SNUG meeting. Lana Kaiser, visiting from Siemens-Japan, talked to Ben and others about glucose in 2015, then returned a year later with a paper on detecting glucose at 7 T. Since then, Lana and Ben have been working on detecting glucose at 3 T, work that will be made public soon.

This year we started getting serious interest in using simultaneous multi-slice (SMS) EPI for fMRI. We've had the sequences for a while, but it seems that the increasing number of published studies is motivating people to take the plunge. This is both good and bad. In general, there is no point trying to use a new pulse sequence, and risk unknown failure modes, if an older sequence can answer your question. Another issue is familiarity and how to set parameters for SMS-EPI. Here, the literature offers conflicting advice, since some of the early studies – most notably those out of the Human Connectome Project – used custom hardware and older sequence versions, and reconstruction, that frequently contained errors. Ben did some empirical testing and devised three broad starting points for SMS-EPI using either the CMRR or MHG pulse sequences. Later in the year, Jo Etzel at WashU motivated a systematic investigation of motion effects in SMS-EPI when she saw something unexpected in her data. It transpired that EPI and SMS-EPI were consistent, but the faster sampling rate (shorter repetition time) facilitated by SMS-EPI was making respiratory fluctuations more apparent for SMS-EPI. No doubt there will be other lessons to learn as more labs explore the capabilities of SMS-EPI.