Agilent (Varian) to Bruker conversion: another first for Oxford.

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Introduction. Following the demise of the Agilent MRI business, various groups are considering (or making) the transition from Varian electronics to a console supplied by another manufacturer. We recently replaced our 4.7 T scanner electronics with those from Bruker, whilst maintaining the same magnet room, magnet, RF coils and animal handling apparatus. The new Bruker scanner had to be integrated into a facility housing SPECT-CT (MILabs), luminescence (Perkin Elmer), Ultrasound (Visualsonics), radiotherapy (Xstrahl), and MRI (Agilent). The issues encountered included: (i) automatic data handling structures within our unit transfer all new data acquired on each scanner to a server with a standardised data directory structure; (ii) the standard RF filter panels supplied by Varian and Bruker are incompatible; (iii) MRI data need to be automatically generated in the NIfTI format; and (iv) different mechanisms are required to perform cardio-respiratory synchronized steady state scan modes with short TR and the automatic reacquisition of data that is corrupted by respiratory motion..We describe some solutions that may help other groups through a similar conversion.

Solutions.

Automatic data storage. Our study names are defined with GroupHead, GroupMember, StudyStartYear, and UniqueNumber identifiers; e.g. SS3_PK2_18_1966. A Tcl/Tk window allows users to select the Study Name from a list of valid names that is determined by menu selection of the user's (GroupMember) name. Other menu selections are Sample (Rodent/Other/Material), Sample Position (Orientation), RF coil and Gradient Coil. A Sample Name can also be entered. The information is used to create a ParaVision study which can be opened by selecting 'File→Import→Datasets…' from the ParaVision main menu bar. This mechanism enables automatic sorting and storing of image files and eliminates study name errors that can arise from manual entry such that data becomes misplaced on the server. .

Filter panel. Our mechanical workshop designed and made a new filter panel to fit the space previously occupied by the Varian filter panel. We cannibalized the Bruker panel and transferred components to the new panel which is mounted using the same screw holes as the original Varian filter panel.

NIfTI files. A perpetual script is launched at boot that periodically scours defined data directory locations for any new Bruker '2dseq' image files. Corresponding NIfTI data are automatically generated in the Bruker scan directory within seconds of each 2dseq file.

Gating input selection. In vivo respiratory, cardiac or respiratory-blanked cardiac signals are used for gating control. A simulator replicates these signals for method development resulting in a total of 6 different input signals. The Varian system has 8 software selectable inputs for gating and scan parameters record the input signal used. The Bruker AVIIIHD has 2 inputs for gating. We use a single input for gating from a custom built 8-channel selector that is set according to the logic levels of the AVIIIHD IPSO port 'U' pinouts 1, 2 and 3. Bruker can supply an adapter cable to connect to the 6 IPSO port 'U' output TTL lines. This implementation enables software selection of the gating input signal which is recorded in the scan parameters.

Steady state MRI with prospectively-gated cardio-respiratory synchronisation. Prospective gating control with respiratory reacquisition was developed in 3D spoiled GRE and balanced SSFP scans modes on the Varian for highly efficient cardio-respiratory synchronised short and constant TR MRI in the mouse [Kinchesh et al. Magn Reson Imaging 2018]. These have become our workhorse scans for imaging in the thorax and abdomen. On the Varian, steady state cardio-respiratory synchronisation is possible with a 2.8 ms jitter about 5 ms after each inter-breath R-wave and the scans operate up to 64 times faster than is possible with retrospective gating. We have programmed these scan modes on the Bruker, but have not been able to achieve the same level of synchrony. On the AVIIIHD the limit appears to be a 30 ms jitter about 18 ms after each inter-breath R-wave. Although cardio-respiratory synchronisation is not possible, this level of performance is perfectly adequate for respiratory gating. We anticipate that Bruker's new electronics will show a considerable improvment in performance

Summary. Images were produced on the day the Bruker equipment was delivered. Each of the issues has been overcome using software and/or hardware solutions that are fairly simple to implement, and these are all available for distribution upon request.