**CIRP DWI Phantom Round Robin**

*April 6, 2023*

**Objective(s)**

Quantify repeatability and reproducibility across multiple NIH/NCI Co-Clinical Imaging Research Resources Program (CIRP) preclinical MRI systems in performing diffusion measurement using a standardized diffusion weighted imaging (DWI) protocol applied to a common phantom containing temperature-controlled medium of known diffusivity.

**Sponsor(s)**

NIH U24 CA-237683

**Organization and Nature of Provided Materials**

1. Products

Summary works in the form of peer-reviewed publication, auxiliary materials and procedures used in conducting the study, and slides outlining the study presented at the NCI CIRP Annual Meeting in 2022.

* 1. Tomography 2023, 9, 375–386. <https://doi.org/10.3390/tomography9010030>
  2. Auxiliary materials:
     1. CIRP\_DWI\_IceWaterPhan\_PrepAndScanProcedure\_20211117.pdf
  3. DWI\_Phantom\_Round-Robin\_Chenevert\_fin.pdf: Presentation to “NCI CIRP Annual Meeting 2022”

1. RawData

Magnetic resonance images (MRI) of the ice water diffusion phantom scanned at 7 academic sites on a total of 10 MRI systems. Sites were instructed to prepare and scan the phantom on 2 Days. Data from two pre-clinical MRI scanner manufacturers were acquired: (1) Bruker (<https://www.bruker.com/en/products-and-solutions/preclinical-imaging/mri.html> ) and (2) MRSolutions (<https://www.mrsolutions.com/mr-imaging/mr-imaging/> ). Data are provided in “MRI vendor-native format” that requires customized image reader software, as well as in Insight ToolKit (ITK) compatible format which is readable by several open-source image viewing software packages. Mean apparent diffusion coefficient (ADC) by Region Of Interest (ROI) analysis performed by each site on their own data are provided in excel files. Subfolders within each contributing site are organized by:

* + 1. SysID
       1. Day1
          1. VendorFormat
          2. ITKFormat
          3. Site ROIs
       2. Day2
          1. VendorFormat
          2. ITKFormat
          3. Site ROIs
    2. DWIPhan\_Site\_DropBoxDownload.zip as received from site

1. Analysis

MR images received from all sites were analyzed centrally (by UMICH CIRP Team) and converted to a uniform ITK-compatible format, MetaImage Header (MHD). Bland Altman analysis of long- and short-term repeatability is provided in excel and Matlab “.mat” files. The excel file “CIRP\_DWI\_RoundRobin\_SummaryStats\_20221014\_ForTomoMS.xlsx” contains all ROI data with active cell equations.

* 1. UM Generated MHDs and ROIs (in excel) are organized in subfolders as:
     1. SysID
        1. Day1: MHDs and ROIs
        2. Day2: MHDs and ROIs
  2. Bland Altman Analysis (supplemental in Tomography 2023 MS)
  3. CIRP\_DWI\_RoundRobin\_SummaryStats\_20221014\_ForTomoMS.xlsx: Master analysis excel workbook organized by tab:
     1. “CoreLab” tab contains short-term (i.e. intra-exam) and long-term (i.e. multi-day inter-exam) repeatability analysis as well as cross-system reproducibility analysis.
     2. “Site\_vs\_CoreLab” tab compared CoreLab (UM)-generated ADC vs Site-generated ADC values.

1. Code

Matlab version R2019b was used for centralized (UMICH) conversion of MRI vendor-format data into uniform MHD format for ROI analysis via an open-source image analysis software package 3DSlicer version 4.6.2. The folder “Code” contains UMICH-created and other relevant Matlab scripts and/or other software tools used at time of the peer-reviewed Tomography publication summarizing this project <https://doi.org/10.3390/tomography9010030> .