

NA-MIC Center Summary

Quantitative image analysis is essential for the extraction of knowledge from biomedical images. The National Alliance for Medical Image Computing (NA-MIC) is a multi-institutional NCBC that is investigating computational methods and delivers tools in a modular, open-source software infrastructure.

RESEARCH IMPACT: *NA-MIC has published 456 papers in peer review journals and conference reports, including several award-winning papers presented at high-end conferences.* The methodology developed by NA-MIC scientists is driven by 11 Driving Biological Projects that address neurodegenerative disorders (schizophrenia and autism), lupus, Huntington's disease, heart disease (atrial fibrillation), radiotherapy for prostate and head and neck cancers, and traumatic brain injury. In addition to scholarly papers, the NA-MIC community makes this software available in the NA-MIC Kit and in an application called 3D Slicer. This software is used worldwide and enables research in the engineering sciences and in biomedical research.

Mobilizing an International, Open-Source, Development Community. NA-MIC has adopted an open and inclusive approach to building a community of scientists around the NA-MIC Kit. In addition to a variety of US activities with NIH grantees, contributions to the NA-MIC Kit have come from substantial government-funded efforts in Canada, Germany, Spain, France, and Italy. Examples of NA-MIC's impact on the international community include the Ontario Consortium for Adaptive Interventions in Radiation Oncology (OCAIRO), which was awarded Canadian funding in 2011 to develop research software for adaptive radiation therapy based on the NA-MIC Kit. The results of this work are made available to the NA-MIC community as extensions. In a similar vein, NA-MIC investigators have co-lead the creation of the Common Toolkit (CTK) effort, an international collaboration with substantial contributions from several European countries.

Combining the Analysis of Genetic and Imaging Data. NA-MIC's work with the NIH-funded COPDGene project (www.copdgene.org) exemplifies the center's impact on collaborative research. NA-MIC technology has enabled the correlation of imaging-derived quantitative measures of airway, parenchymal, and vascular phenotypes with a spectrum of established pulmonology diagnostic metrics and a genome-wide association study. This analysis has established that genes near *CHRNA-3/5* and *MMP-12/13* can determine the genetic predisposition of an individual to develop COPD. This same conceptual approach of combining quantitative image analysis based on the NA-MIC Kit with genetics is being used in a second multi-center study called PREDICT-HD which is run by a Huntington's disease (HD) consortium led by the University of Iowa. The PREDICT-HD consortium uses the NA-MIC Kit to research quantitative medical imaging bio-markers as surrogate endpoints in drug treatment trials that are aimed at delaying disease onset and/or progression.

COMMUNITY RESOURCES/SOFTWARE/COLLABORATIONS: NA-MIC's algorithms and tools have been broadly adopted by the community and by industry. 3D Slicer was downloaded 32,000 times in the past 12 months. 3D Slicer's user and developer mailing lists contain 829 and 483 members, respectively. CMake, a multi-platform developer environment, is one of the most popular components of the NA-MIC Kit, and has an impact beyond the biomedical field. This package has more than 2,000 known downloads/day. NA-MIC has 31 funded collaborations: these include 25 NIH grants (8 active, 17 completed) and 6 international grants (5 active, 1 completed). These collaborations address a broad range of organ systems and pathologies: diagnosis and therapy of schizophrenia, lupus erythematoses, autism, lung disease, cardiac disease, cancer of the brain, liver, colon, and prostate, and musculoskeletal disorders.

TRAINING & DISSEMINATION: NA-MIC scientists have directly mentored over 55 software engineers, 35 doctoral students, and 20 postdoctoral fellows. In addition, NA-MIC has trained over 2,000 investigators in the use of 3D Slicer and other components of the NA-MIC Kit through 63 hands-on workshops. To complement these customized events, NA-MIC has developed a freely available online training compendium, consisting of 88 detailed tutorials. A different type of research is presented in the grand challenge workshops at premier conferences, such as the pioneering initiative on standardized evaluation of diffusion tensor imaging tractography algorithms for neurosurgical planning at MICCAI. Finally, NA-MIC practices the best principles of collaborative science through its semi-annual Project Week events. To date, it has held 15 consecutive events, where experts and students gather to address current research problems. These events have grown tremendously since inception, now attracting more than 100 participants per venue, and the event has been recognized and adopted by several other centers.