TCIA Sustainment and Scalability – Platforms for Quantitative Imaging Informatics in Precision Medicine

11/3/2017

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Overview

- **Precision Medicine** requires the ability to classify patients into specialized cohorts that differ in their susceptibility to disease, in the biology and/or prognosis of the diseases they develop, or in their response to therapy. Identifying quantitative imaging phenotypes across scale through the use of radiomic/pathomic analyses is an evolving approach to cohort identification and to improving our understanding of cancer biology. These analytic techniques require large collections of well-curated data for algorithm testing and validation.

- Since 2011 the Cancer Imaging Archive (TCIA) has encouraged and supported cancer-related open science research by acquiring, curating, hosting and managing collections of multi-modal information. To remain relevant to its current research community TCIA must undergo continuous improvement and expansion of its capabilities guided by the research community.

- The TCIA user community has identified four critical areas for improvement:
  - expanded resources for integrative Image-Omics studies,
  - enhanced capacity to acquire high quality data collections,
  - resources to support validation studies and Research Reproducibility,
  - increased community engagement.
Specific Aims

• **Aim 1:** Deploy expanded resources for Integrative Image-Omics Studies.
  – expanded capabilities in data driven information integration, semantic query capability and feature management

• **Aim 2:** Increase capacity to acquire high quality data collections.
  – extend and automate curation processes to increase TCIA’s collections and add new types of data based on priorities established by our Research Advisory Committee
  – consolidate the TCIA software stack into a set of easily deployable entities to reduce TCIA’s long-term internal operational costs

• **Aim 3:** Enhance resources to support validation studies and research reproducibility.
  – deploy a set of tools and capabilities to directly support ITCR imaging grand challenges

• **AIM 4:** Emphasize Community Engagement, Collaboration and Dissemination.
  – Research Advisory Committee will be created to provide direct community guidance on TCIA enhancement and collection priorities.
Research Advisory Committee

- This group of experts will provide direct community guidance on TCIA enhancements and collection priorities.
- Dr. TJ Fitzgerald has agreed to chair the RAC and the following senior scientists have agreed to participate:
  - Dr. Michael McNitt-Gray (UCLA),
  - Dr. Jayashree Kalpathy-Cramer (Harvard),
  - Dr. Metin Gurcan (OSU),
  - Dr. Samuel Achilefu (Washington University),
  - Dr. Hugo Aerts (Harvard).
- NCI will also provide a liaison to the RAC.
Image Derived Features

- Annotations, Segmentations, Radiomics feature sets are being submitted to TCIA
- Current management mechanisms only support discovery and download
- Growing need for a feature ontology and a “featurebase”
Evolving the Repository Architecture

GUI and Visualization (Clients)

Indexing and Search Engines

Analytics Engines

Data Access Engines

Other Repositories

TCIA Distributed Object Store

Stoneybrook

UAMS

Emory

Google

AWS
In Summary

The sustainment of TCIA and research community directed expansion of its capabilities will ensure this valuable resource continues to promote research reproducibility and data reuse in cancer precision medical research.