
Abstract

The ultimate goal of the HIVE Mapping effort is to develop a common coordinate framework (CCF) for the healthy human body that supports the cataloging of different types of individual cells within anatomical structures, understanding the function and relationships between those cell types, and modeling their individual and collective functions. In order to exploit human and machine intelligence, different visual interfaces are implemented in support of CCF data generation, exploration, and communication. The CCF and interactive data visualizations are multi-level and multi-scale. They support the registration and exploration of diverse types of data—from single cells to whole body. In the initial two years, MC-IU ran user needs analyses with stakeholders, compiled an initial CCF ontology and associated 3D object library, developed novel CCF registration and exploration UIs, and explored using the vasculature as a coordinate system to map all cells in the human body.

Common Coordinate Framework

A common-coordinate framework (CCF) is a conceptual and computational framework for the storage, analysis, and (visual) exploration of spatially and semantically indexed data—across individuals, technologies, labs.

CCF Registration to CCF Exploration Workflow

The CCF Core Model has been defined as a formal ontology using Web-ontologies Language 2 (OWL) to support compatibility and interlinkage with other ontologies.

CCF Ontology

Semantic zoom from whole human body, to organs, to functional tissue units (FTUs), to FTU sub-structures, to single-cell level.

CCF 3D Object Library

In collaboration with Kristen Brown at National Institute of Allergy and Infectious Diseases (NIAID), NIMI is developing a library of anatomically correct human organ models using data from NLM’s Visible Human (VH) dataset.

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Publications

• MC-IU TMCs, NIAID, Conceptualization, Construction, Validation, and Usage of a Human Body Common Coordinate Framework. Draft available for expert comments.

CCF Registration User Interface (RUI)

The RUI was designed for usage by experts that collected human tissue and need to document the tissue extraction site. It requires about 5-10 minutes of training and 2-3 minutes for each tissue registration. Currently, the RUI supports gross anatomical tissue registration of tissue blocks. When biomechanical data becomes available, it will be extended to support placement based on biomechanical markers and patterns.

CCF Visualization User Interface (EUI)

The EUI makes it possible to explore 2D/3D tissue data semantically and spatially across multiple scales. Spatial data generated by the RUI is used to position tissue blocks. Cell segmentation algorithm results will soon support TUI-based cell type exploration. Semantic and spatial search, browsing, filtering, and details on demand are supported.

CCF Ontology Model. see https://hubmapconsortium.github.io/ccf-ontology/cff.owl