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Pathology Digital Imaging Core Facility / NWBioSpecimen / University of Washington Department of Pathology

Whole Slide Scanning and Quantitative Image Analysis Services

Introduction to Services and Pricing

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Introduction

NWBioSpecimen, a core facility housed within the University of Washington Department of Pathology, provides biospecimen procurement, annotation data associated with the biospecimens, and distribution of materials for research and education.

NWBioSpecimen brochure: https://goo.gl/4gwa64.

Among our annotation services are **digital pathology services** including whole slide scanning and quantitative image analysis of histologic features.

Pathology Digital Imaging Core Facility brochure: https://goo.gl/mLybCv.

Whole Slide Scanning and Image Hosting

Services:

- *Brightfield whole slide scanning at 20X (0.50µm/pixel) or 40X (0.25µm/pixel) objectives*

- *Image hosting in a web accessible UI*

- *Online project and slide management*

- *Account creation for sharing scanned slides*

- *Support for creating publication/grant figures*

- *Basic training*

The Pathology Digital Imaging Core Facility, a component of the UW Department of Pathology NWBioSpecimen core facility, is directed by Mr. Jonathan Henriksen, (jhenrik@uw.edu, 206-221-5830). The facility provides brightfield whole-slide histologic imaging suitable to prepare publication-quality figures and quantification of selected features from digitized images.

Facilities and Equipment: The Digital Imaging Facility has two locations. A 180 ft2 office located in room RR846 of the UW Health Sciences Building has computerized (auditable) keypad access, a private office for the Digital Imaging Coordinator, and three additional workstations equipped with new PCs. The facility is equipped with an Aperio ScanScope CS digital whole slide scanner networked to two dedicated Dell PowerEdge R510 servers equipped with Aperio eSlide Manager server applications and Aperio Brightfield Toolbox image analysis software. These servers each contain 15TB of direct-attached storage, and are hosted in the University of Washington enterprise class data center with automated nightly backups to two secure geodiverse locations. One of the workstations is equipped with a Wacom Cintiq 24HD pen tablet annotation screen. An auxiliary 601 ft2 image analysis facility located in room 421 of the Research and Training Building on the UW Harborview Medical Center campus has 3 workstations with new PC computers and a Wacom Cintiq 22HD pen tablet annotation screen. Having two locations facilitates access by the Director and other consultative pathologists who rotate between these sites during their clinical duties, as well as research clients who are situated on multiple campuses in Seattle.

We have developed services as a recharge center to recover the costs associated with owning the equipment and providing the services (scanner, software, servers, support contracts, and personnel).

Services Detail:

The Aperio ScanScope CS is used to prepare diagnostic quality brightfield whole slide image scans (WSI) at 20X (0.50µm/pixel) or 40X (0.25µm/pixel) magnification. Scanned slides may be viewed at any magnification up to the scanning resolution. The 20x and 40x scanning resolutions correspond to viewing cell sizes on a microscope through 20x or 40x objectives with 10x eyepieces. The Wacom Cintiq 24HD pen tablet screen is used for region of interest annotation. Whole slide images may be analyzed using image analysis software to quantify area staining or cells by nuclear, membrane, and cytoplasmic staining of any chromogen (*See Quantitative Image Analysis Services below*).

You get online access (*https://slides.pathology.washington.edu*) to your whole slide images on computer and iPad for viewing and capturing publication quality snapshots. You can optionally have multiple online accounts created to collaborate with co-investigators by sharing scanned slides, annotations, and analysis data securely. Slide images are immediately available on the server after scanning and assigning to your account. All slide scans are hosted on our secure servers with automated nightly backups.

Additional services can be provided. Please inquire for more detailed information:

- Import existing whole slide scans or related images (Aperio SVS, Hamamatsu NanoZoomer NDPI, Zeiss Mirax MRXS, JPG, TIFF) into our servers.

- Convert whole slide images into other image formats.

- Upload scanned slides to another server or copy to your external hard drive.

- Create DVD of whole slide images.

- Provide support for creating figures for grants/publications and presenting complex data in organized infographics.

- Developing custom web applications using whole slide images, e.g. slide scoring surveys.

Quantitative Image Analysis Services

Services:

- *Quantitative image analysis*

- *Pathologist consultation (digital annotation, verification, histopathology consulting)*

- *Digital imaging technician consultation (digital annotating, algorithm optimization, image analysis, and data processing)*

- *Scientist consultation (digital annotating, algorithm optimization, image analysis, and data processing)*

Using Aperio Brightfield Image Analysis Toolbox software, we can annotate regions of interest and quantify histologic features and immunohistochemical staining within tissue objects, cells, or other areas. This suite of image analysis algorithms includes Cell Quantification (Nuclear, Membrane, and Cytoplasmic IHC staining analysis), Area Quantification (IHC staining densities measured over area by color deconvolution, and staining coexpression of 2-3 stains), Object quantification (microvessel density, and rare event detection/micrometastasis). Aperio GENIE histology pattern recognition analysis software is used to classify tissue structures and automatically perform a specific quantification inside trained classifications of tissue.

These quantification methods yield continuous variable data suitable for statistical analysis. These methods are easily adjustable to studies utilizing tissue microarrays (TMAs) for performing high-throughput analyses.

Image analysis algorithms are calibrated and tuned for each set of slides on computers in our facility with the necessary software licenses. All annotation and analysis data are stored on the server and can be retrieved and shared by users who have permissions to access the scanned slides.

These services are billed on an hourly rate. Please work with us to develop a statement of work and budget estimate. Once the project is complete, the final dataset and report are delivered to the investigators for statistical analysis.

Example publications using quantitative image analysis on the Aperio platform

1. *Tissue classification (Automated ROI selection)*
   Quantitative comparison of immunohistochemical staining measured by digital image analysis versus pathologist visual scoring. Rizzardi AE, Johnson AT, Vogel RI, Pambuccian SE, Henriksen J, Skubitz AP, Metzger GJ, Schmechel SC. Diagn Pathol. 2012 Jun 20;7:42. doi: 10.1186/1746-1596-7-42. PMID: 22515559

2. *Microvessel Density (Object Quantification)*
   Microvessel density is not increased in prostate cancer: digital imaging of routine sections and tissue microarrays. Tretiakova M, Antic T, Binder D, Kocherginsky M, Liao C, Taxy JB, Oto A. Hum Pathol. 2013 Apr;44(4):495-502. doi: 10.1016/j.humpath.2012.06.009. Epub 2012 Oct 12. PMID: 23069258

3. *Cytoplasmic immunohistochemical staining quantification (Cell quantification)*
   Canonical Wnt/β-catenin signaling drives human schwann cell transformation, progression, and tumor maintenance. Watson AL, Rahrmann EP, Moriarity BS, Choi K, Conboy CB, Greeley AD, Halfond AL, Anderson LK, Wahl BR, Keng VW, Rizzardi AE, Forster CL, Collins MH, Sarver AL, Wallace MR, Schmechel SC, Ratner N, Largaespada DA. Cancer Discov. 2013 Jun;3(6):674-89. doi: 10.1158/2159-8290.CD-13-0081. Epub 2013 Mar 27. PMID: 23535903

4. *Area based immunohistochemical staining quantification (Area Quantification)*
   Expression of FAP, ADAM12, WISP1, and SOX11 is heterogeneous in aggressive fibromatosis and spatially relates to the histologic features of tumor activity. Misemer BS, Skubitz AP, Carlos Manivel J, Schmechel SC, Cheng EY, Henriksen JC, Koopmeiners JS, Corless CL, Skubitz KM. Cancer Med. 2013 Nov 26. doi: 10.1002/cam4.160. PMID: 24402778

5. *Aperio application programming interfaces (Custom software development)*
   Development of multigene expression signature maps at the protein level from digitized immunohistochemistry slides. Metzger GJ, Dankbar SC, Henriksen J, Rizzardi AE, Rosener NK, Schmechel SC. PLoS One. 2012;7(3):e33520. doi: 10.1371/journal.pone.0033520. Epub 2012 Mar 15. PMID: 22438942

Project Management
Most projects progress through the following steps:

1. Initial inquiry.

2. Understanding around the project statement of work (SOW).

3. Establishment of a Budget and detailed plan to match the SOW.

4. Formal contract acceptance (external projects) or go-ahead (for internal projects).

5. We do work and deliver services.

6. Customer is invoiced and pays for the work per Budget.

Approved Rates

Current rates can be found on our website at https://depts.washington.edu/nwbios/researchers/rates-for-services. A valid UW NetID is required to access the rates.

If you are external client, please contact us at nwbios@uw.edu for our current rates.

Our rates are reviewed on a regular basis by the University of Washington Office of Management Accounting and Analysis and are subject to change. For grant purposes, or for other work to done in the future, it is recommended that potential rate increases be considered for budget planning.

Submitting Slides for Scanning

1) Complete the **Slide Scan Request Form**. Project name, description, PI/contact name, and budget number must be included with all requests. The Slide Scan Request Form can be provided electronically.

2) Bring the slides and request form to Jonathan Henriksen in Health Sciences RR846, or drop them off in the digital imaging slide drop box in UWMC/HSB NE110 Pathology Office (on the far right side of the boxes).

   Courier service is also available from the Harborview Pathology Department. When you drop slides off, you must fill out a *UWMC Pathology Room BB220 Courier transport form*. Please check the NE110 Mailbox option, and fill in J. Henriksen (Imaging) in the TO line.

3) You will be notified via email once the slides are scanned.

Accessing the NWBioSpecimen Aperio Digital Slide Server

Aperio eSlide Manager is a digital pathology image server with a web based interface and slide information management component. Research slides are organized into groups by your project and assigned metadata such as project name, slide set, tissue site, stain, and block number. eSlide Manager also stores digital slide annotations and image analysis data.

Secure access to slides and metadata is governed by user accounts with permissions to specific data groups.

1) Open the UW Aperio eSlide Manager server and log in with your account:
   https://slides.pathology.washington.edu

Contact Jonathan Henriksen at jhenrik@uw.edu or 206-221-5830 for an account.

2) Once you see the welcome page, please click on the Projects icon to see the different sets of slides you can access.

3) Access to slide images is governed by roles and permissions on your user account. You will only see and be able to edit those slides which are within your allowed access groups.

4) For more information about using the website and Aperio slide viewing software, please refer to the *Aperio Software Introduction for Researchers* document.