Tools for knowledge management of the neuroscientific literature, the fragmenter and atlas viewer plugins for the NeuroScholar system. •

Gully A.P.C. Burns[1], Kevin Chan[1], Atousa Golapayani[1], Shahram Ghandeharizadeh[2] & Cyrus Shahabi[2]

[1] The K-Mechanics Research Group, University of Southern California, Los Angeles, CA 90089-2520

[2]: Henry Salvatori Computer Science Center,University of Southern California, Los Angeles, CA 90089-0781

Abstract

We describe two user interface plugins for the NeuroScholar literature-based knowledge management system: the Fragmenter and Atlas-mapper. The Fragmenter allows users to select textual and graphical excerpts from a paper that may be used to support interpretations and arguments made within the knowledge base. The system permits fragment storage, retrieval and editing. The Atlas-mapper allows users to delineate volumes of neural tissue as stacks of closed bezier curves drawn onto stacked atlas plates. We will include computational demonstations in our poster presentation.

• Poster Presentation

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The NeuroScholar project

The NeuroScholar project is an online computer system where users may construct, manipulate and store representations of 'neuroscientific knowledge' derived from published studies in the literature. The design of the system as a whole has been described in detail elsewhere [1,2,3] and will be covered very briefly here. Each user may represent their individual interpretations of physiological and anatomical data from publications in the literature into computational representation of a standard neuroanatomical atlas [4]. These interpretations form a 'knowledge model' of the data under study for the individual user. At present the system is primarily concerned with neural connectivity, in a similar way to other existing connectivity databases [5, 6], but may be used to represent any variable that is based on parcellating neural tissue into regions. The NeuroScholar project is built with software engineering tools that permit rapid redesign and automated generation of new systems based on changes and variation in their underlying data-model [7].

Our presentation addresses two essential user-interface components of the NeuroScholar system that provide the essential functionality for the execution of this design. The first of these plugins, the Fragmenter, allows users to break up a publication into the 'fragments' (*i.e.*, text-based and graphical excerpts) that support a specific interpretation. The second, the Atlas-mapper, allows users to delineate structures on the plates of a brain atlas so that they can estimate (in the atlas) the likely location of borders of regions derived from data in a paper.

It is important to note that the rate-determining step for neural connectivity databases based on the literature was data-entry [5, 6]. Both plugins presented here simplify and accelerate this.

The Fragmenter plugin

The construction of knowledge models within NeuroScholar revolves around supporting the models' definition with excerpts directly taken from papers. Adobe's Portable Document Format (PDF) is emerging as the industry standard within electronic publishing [8] and at present the Fragmenter operates solely on publications in this format. The plugin performs three tasks.

1) It provides a graphical user interface for users to highlight passages of text and figures in a PDF document as 'fragments' so that they may be uploaded to our centralized server. Fragments may span multiple pages. They may not be made up of discontinuous passages (for example, text from a figure legend and text from the main body of the paper may not be included in the same fragment).
2) It allows users to retrieve previously defined fragments so that they may be viewed and edited.
3) It allows the fragments to be linked to interpretations formed within the NeuroScholar system.

The exact nature of the data that we may store is dictated by the owner of the publication's copyright and so we have several strategies underpinning the quality of data that we may store. If the publisher permits us to store the content of the paper, each fragment may consist of the original text used in the article, an image

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of the text as it appears in the article and the location of the polygon enclosing the fragment. If the publisher refuses to allow us to store the paper's content, we may still store the location of the fragment's enclosing polygon.

The Atlas-mapper plugin

Identifying the precise neuroanatomical position of data when reading a paper depends on choices made by the original authors. These include their attention to detail, the plane of section used, the graphics software and artistic skill and whether (or not) they mapped their data with an atlas. The Atlas-mapper plugin allows users to represent volumes of neural tissue as stacks of closed bezier-splines over scaled images of the plates of a brain atlas. We permit users to zoom to any level of magnification in the atlas.

Since these delineations are based on user's interpretations of the likely location of borders, we include a component called 'Fuzzy Bezier Splines' (FBS) to allow them to estimate the error of their delineation. The graphical controls of FBS are illustrated in Figure 1. Essentially, the FBS handles define the extent of a 'border zone' where inclusion in the structure may be defined probabilistically so that the central anchor point has a 0.5 probability of being inside the structure and each the Fuzzy Spline Handles lie one standard error either inside or outside the structure.

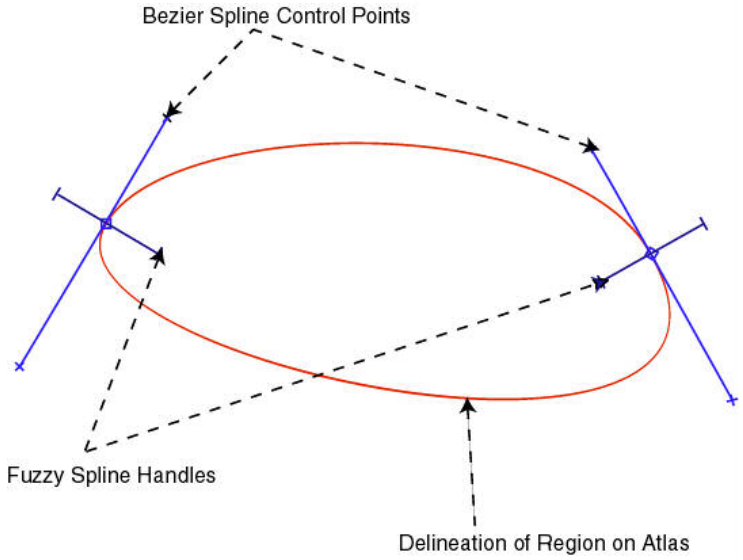

Figure 1: A single closed spline, defined with fuzzy spline points.

Within NeuroScholar, this tool will be used to delineate any volume of brain tissue of interest (injection sites from tract-tracing experiments, electrophysiological recording sites, histological labeling, *etc.*).

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