4th Eurographics Workshop on Visual Computing for Biology and Medicine

Program

September 3-5, 2014
Vienna, Austria

Satellite Events:
VisBio 2014
www.cg.tuwien.ac.at/VisBio2014

GI VCBM Working Group Meeting
www.fg-medvis.de
How to get to the venue

Take tram number 43 or 44 from U2 stop “Schottentor”. Get off at “Lange Gasse” (2nd stop from Schottentor), circled blue in the map below. Hörsaal D is in the building marked red. The black dotted line marks the way to the venue through the campus. The venues of Wednesday’s social events are marked green.

Important Information

VCBM Social Event Thursday, 19:30 - 23:00

With 612 hectares of vineyards, Vienna is the number One winegrowing capital of the world, and its smallest vineyard even is located in the first district on Schwarzenbergplatz. Thus, the VBCM2014 social event will be taking place close to one of the most famous vineyard areas of Vienna, Cobenzl, at the restaurant Waldgrill Cobenzl.

Useful Information

Venue Address
Hörsaal D, Hof 10, Universitätscampus Altes AKH
Spitalgasse 4
1090 Vienna

Narrenturm
Hof 6, Universitätscampus

Meet and Greet
Hof 1, Universitätscampus

Contact
mail: vcbm@cg.tuwien.ac.at
twitter: @vcbm_2014

Web Proceedings
www.cg.tuwien.ac.at/vcbm2014
user: vcbm2014
password: we_see_bee_am

VCBM Social Event Address
Restaurant Waldgrill Cobenzl
Am Cobenzl 96
1190 Vienna
www.waldgrill-cobenzl.at

Please, bring the invitation card with you!

Taxi
+43 (0) 1 31 300
+43 (0) 1 40 100
+43 (0) 1 60 160

Public Transport
www.wienerlinien.at
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<td>9:00 - 9:30</td>
<td>Systems Genetics of Root Growth</td>
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<td>9:00 - 9:30</td>
<td>Wolfgang Busch</td>
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<td>Gregor Mendel Institut, Vienna BioCenter</td>
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<td>Illustrating Polymerization using Three-level Model Fusion</td>
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VCBM Registration
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VCBM
9:00 - 9:15
Opening
9:15 - 10:00
Keynote: Medical Visualization, what next?
Anna Vilanova
TU Delft, Netherlands

Anna Vilanova has been developing research in the field of Medical Visualization for more than fifteen years. She is currently leading a group that deals with different aspects of Medical Visualization within the computer graphics and visualization group at Delft University of Technology. The rapid evolution of medical imaging scanners provides imaging information that continuously increases in size and complexity. Furthermore, other sources of information, e.g., genome expression data, are becoming available in clinical settings. Exploiting the rich information present in that data poses visualization challenges that far go beyond the traditional volume rendering. In this talk, she will present her view on the past, present and future of medical visualization as a research field.

Coffee Break
10:15 - 10:45

Multivariate Data Analysis
10:45 - 11:45

Chair: Dorit Merhof

10:45 - 11:05
Robust Cardiac Function Assessment in 4D PC-MRI Data
Köhler, Benjamin; Preim, Uta; Gutberlet, Matthias; Fischbach, Katharina; Preim, Bernhard

Four-dimensional phase-contrast magnetic resonance imaging (4D PC-MRI) is a relatively young imaging modality allowing to capture time-resolved, three-dimensional blood flow information. Stroke volumes and regurgitation fractions are two of the parameters, which are required for their quantification. Unfortunately, the calculations are highly sensitive towards the plane’s angulation since orthogonally passing flow is considered. This often leads to physiologically implausible results. In this work, a robust quantification method is introduced to overcome this problem. Collaborating radiologists and cardiologists were carefully observed while estimating stroke volumes in various healthy volunteer and patient cases with conventional quantification. This facilitated the automation of their approach which, in turn, allows to derive statistical information about the plane’s angulation sensitivity. Moreover, the experts expect a continuous decrease of the stroke volume along the vessel course after a peak value above the valve area. Conventional methods are often unable to produce this behavior. Thus, we present a procedure to fit a function that ensures such physiologically plausible results. In addition, the technique was adapted for the robust quantification of regurgitation fractions. The performed informal evaluation shows the capability of our method to support diagnosis, a parameter evaluation confirms the robustness. Vortex flow was identified as main cause for quantification uncertainties.

11:05 - 11:25
The iCoCooN: Integration of Cobweb Charts with Parallel Coordinates for Visual Analysis of DCE-MRI Modeling Variations
Raidou, Renata; Breuwer, Marcel; Vilanova, Anna

Efficacy of radiotherapy treatment depends on the specific characteristics of tumorous tissues. For the determination of these characteristics, clinical practice uses Dynamic Contrast Enhanced Magnetic Resonance Imaging (DCE-MRI) data is acquired and modeled using pharmacokinetic modeling to derive per voxel a set of parameters, indicative of tissue properties. Different pharmacokinetic modeling approaches lead to different assumptions, resulting in parameter estimates with different distributions. A priori, it is not known whether there are significant differences between modeling assumptions and which assumption is best to apply. Therefore, clinical researchers need to know at least how different choices in modeling affect the resulting pharmacokinetic parameters and also how pairs of parameters are correlated. To get a better understanding of the parameter space and how to best combine these assumptions, a review of methods is introduced to iCoCooN. iCoCooN is a visualization application that appeared in the context of 3D visualization methods and was originally designed for the exploration of functional Magnetic Resonance Imaging (fMRI). Since then, this tool has been used in many areas. The iCoCooN approach was extended to the visualization of DCE-MRI data and modeling results. A series of carefully selected and well matched visualizations were designed to support diagnosis and treatment planning.

11:25 - 11:45
A Survey on Visualizing Magnetic Resonance Spectroscopy Data
Nunes, Miguel; Laruelo, Andrea; Ken, SoleaKhen; Laprie, Anne; Bühler, Katja

Data from Magnetic Resonance Spectroscopy Imaging (MRSI) contains signals about biomarkers concentrations, which are used to achieve new knowledge about biochemical processes. These support diagnosis, treatment, and, especially, enables them to find anatomical correspondences. The results of the evaluation with general users indicate that the Cocoon produces more accurate results compared to independent multiples.

Segmentation and Uncertainty
11:45 - 12:45

Chair: Bernhard Kainz

11:45 - 12:05
Extracting and Visualizing Uncertainties in Segmentations from 3D Medical Data
Faltin, Peter; Chaisawong, Kraisorn; Kraus, Thomas; Merhof, Dorit

Assessing surface of segmentations extracted from 3D image data for medical purposes requires dedicated extraction and visualization methods. In particular, when assessing follow-up cases, the exact volume and confidence level of the segmentation surface is crucial for medical decision-making. This paper introduces a new processing chain comprising a series of carefully selected and well matched steps to determine and visualize a segmentation boundary. In a first step, the surface, segmentation confidence and statistical partial volume are estimated locally. In contrast to existing methods, the proposed approach is able to guarantee the estimated volume for the whole segmentation, which is an important prerequisite for clinical application. Furthermore, a novel visualization method is presented which was specifically designed to simultaneously provide information about 3D morphology, confidence and possible errors. As opposed to classical visualization approaches that take advantage of color and transparency but need some geometric mapping and interpretation from the observer, the proposed scattered visualization utilizes density and scattering, which are much closer and more intuitively related to the original geometric meaning. The presented method is particularly suitable to assess pleural thickenings from follow-up CT images, which further illustrates the potential of the proposed method.

12:05 - 12:25
Uncertainty-aware Ensemble of Classifiers for Segmenting Brain MRI Data
Al-Taie, Ahmed; Hahn, Horst; Linsen, Lars

Estimating and visualizing uncertainty in medical image segmentation has become an active research area due to the necessity of making medical experts aware of possibly wrong segmentation decisions. Still, to our knowledge all these methods are based on a single choice of the underlying segmentation approach. Segmentation using an ensemble of classifiers (or committee machine) use multiple classifiers to increase the performance when compared to applying a single classifier. In this paper, we propose methods to estimate uncertainties in segmentations produced by ensembles of classifiers. We investigate and compare the different combining strategies of the segmentation results of the ensemble members from an uncertainty point of view. We discuss why some combining strategies tend to perform better than others. Also, we visualize the estimated uncertainties using a color mapping in image space and propose a post-segmentations connection step to classify the noisy pixels in the final result based on the statistical uncertainty.

12:25 - 12:45
Inlier Detection in Thermal Sensitive Images
Zadicario, Eyal; Carmi, Neta; Ju, Tao; Cohen-Or, Daniel

Image guidance of medical procedures may use thermal images to monitor a treatment. We present a novel outlier detection method for thermal images that results in reliable thermal information to support medical decision making. Outliers in thermal images are particularly challenging to detect using conventional methods, because they are significantly more difficult to interpret than other image features. One way of using outlier detection is by finding inliers. Outlier detection methods are based on statistical analysis, energy minimization, optimization, etc. Our outlier detection method is physically-based: it is motivated by the fact that heat propagation in soft tissues can be modeled. Pixels are classified as inliers only if the temperature pattern in a spatial and temporal neighborhood strongly correlates with the local temperature pattern. By utilizing the temperature pattern, the correlation process includes a 2D filter in the spatial domain and a 3D filter in the spatial and temporal domains. Experiments with real data have shown that our method produces reliable results with annotations provided by human experts even in outlier-laden images. The technique has been integrated in a true clinical environment and is being used to aid physicians in analysis of thermal images.
Microscopy

14:15 - 15:15
Real-Time Dense Nucleus Selection from Confocal Data

Wan, Yong; Otsuna, Hideo; Kwan, Christen; Hansen, Charles

Selecting structures from volume data using direct over-the-surface interactions such as a paint brush is perhaps the most intuitive method in a variety of application scenarios. Unfortunately, it seems difficult to design a powerful tool that is effective for all different structures in biology research. In [WOCH12b], an interactive technique was proposed for exploring neural structures from confocal microscopy data. It uses a dual-stroke paint brush to select desired structures directly from volume visualizations. However, the technique breaks down when it is applied to selecting densely packed structures with condensed shapes, such as nuclei from zebrafish eye development research. We collaborated with biologists studying zebrafish eye development and adapted the paint brush tool for real-time nucleus selection from volume data. The morphological diffusion algorithm used in the previous paint brush is restricted to gradient descending directions for improved nucleus boundary definition. Occluded seeds are removed using backward ray-casting. The adapted paint brush is then used in tracking cell movements in a time sequence dataset of a developing zebrafish eye.

Imaging the Vascular Network of the Human Spleen from Immunostained Serial Sections

Ulrich, Christine; Lobachev, Oleg; Steiniger, Birte; Guthe, Michael

The spleen is one of the organs, where the micro-structure and the function on that level are not completely understood. It was for example only recently found that is has an open circulation, which distinguishes it from all other organs. Imaging the complete vascular network of the spleen would greatly facilitate research in this area. The structure of such tissue is best uncovered using immunohistochemical staining. This can however only be applied to thin tissue sections and larger structures span several slices. Due to the deformation induced when cutting the specimen, standard registration algorithms cannot be used to merge the images into a volume. We propose a specialized matching algorithm to robustly delineate corresponding regions in the images. After a rigid alignment of the scans, we use a cubic B-spline to deform and align the images. During this process we minimize the total deformation to produce as accurate results as possible.

Interactive Labeling of Toponome Data

Oeltze-Jafra, Steffen; Pieper, Franz; Hillert, Reyk; Preim, Bernhard; Schubert, Walter

Biological multi-channel microscopy data are often characterized by a high local entropy and phenotypically identical structures covering only a few pixels and forming disjoint regions spread over, e.g., a cell or a tissue section. Toponome data as an example, comprises a fluorescence image (channel) per protein affinity reagent, and capture the location and spatial distribution of proteins in cells and tissues. Biologists investigate such data using a region-of-interest in an image view and a linked view displaying information aggregated or derived from the channels. The cognitive effort of moving the attention back and forth between the views is immense. We present a tool that allows for the in-place annotation of multi-channel microscopy data in 2D and 3D. Our tool provides smooth animations of the movement of tunnels changing their length and shape throughout the simulation.

Membrane Mapping: Combining Mesoscopic and Molecular Cell Visualization

Waltemate, Thomas; Sommer, Björn; Botsch, Mario

Three-dimensional cell visualization is an important topic in today’s cytology-affiliated community. Cell illustrations and animations are used for scientific as well as educational purposes. Unfortunately there exist only few tools to support the cell modeling process on a molecular level. A major problem is the immense intra-cellular size variation between relatively large mesoscopic cell components and small molecular membrane patches, which makes both modeling and visualization of whole cells a challenging task. In this paper we propose an 'membrane Mapping' as an interactive tool for combining the mesoscopic and molecular level. Based on instantly computed local parametrizations we map patches of molecular membrane structures onto user-specified regions of cell components. By designing an efficient and GPU-friendly mapping technique, our approach even allows to map and visualize pre-computed molecular dynamics simulations in real-time. This enables the visualization of whole cells on a mesoscopic level with an interactive magnifier tool for inspecting their molecular structure and dynamic behavior.

Visualizing Movements of Protein Tunnels in Molecular Dynamics Simulations

Kozlíková, Barbora; Jurčík, Adam; Byška, Jan; Strnad, Ondřej; Sochor, Jiří

Analysis and visualization of molecules and their structural features help the biochemists and biologists to better understand the protein behavior. Studying these structures in molecular dynamics simulations even enhances this understanding. In this paper we introduce three approaches to the animation of specific inner pathways composed of a empty space between atoms, called tunnels. These tunnels facilitate the transport of small molecules, water solvent and ions in many proteins. They help to understand the structure-function relationships of proteins and the knowledge of tunnel properties improves the design of new inhibitors. Our methods are derived from selected tunnel representations when each stresses some of the important tunnel properties (i.e. visualization of coiled-up and uncoiled, mapping of physico-chemical properties, etc.). Our methods provide smooth animations of the movement of tunnels changing their length and shape throughout the simulation.

Visual Analytics for Biology

16:15 - 17:15
Chair: Stefan Zachow
16:35 - 16:55
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Evaluation of Transfer Function Methods in Direct Volume Rendering of the Blood Vessel Lumen
Láthénn, Gunnar; Lindholm, Stefan; Lenz, Reiner; Borja, Magnus

Visibility of contrast enhanced blood vessels in CT angiography data presents a challenge due to varying concentration of the contrast agent. The purpose of our work is to explore solutions for improving visualizations in blood vessels using different 3D visualisation strategies, their suitability and the feasibility for diagnostic conclusions. We compare a standard visualization approach with a recent method which can adapt to the contrast agent concentration. Both methods are evaluated in a parallel setting where the participant is instructed to produce a complete visualization of the vessel lumens, including both large and small vessels, in cases of contrasted vessels in the legs. The resulting visualizations are then compared in a side-by-side comparison to assess the correctness of the visualized lumens. The results indicate that the participants generally overestimated the size of the vessel lumens using the standard visualization, whereas the locally adaptive method better conveyed the true anatomy. The participants did not find the interactive medical toolbox to be too intuitive, but also noted that this did not introduce any prohibitive complexity in the work flow. The observed trends indicate that the visualized lumens correctly depend on the contrast agent concentration, however the standard visualization may be inherently local rather than global. We conclude that methods, that permit local adjustments, such as the method investigated in this study, can be beneficial to certain types of visualizations of large vascular trees.

Visibility-Driven Processing of Streaming Volume Data
Solteszova, Veronika; Birkeland, Åsmond; Viola, Ivan; Brucker, Stefan

In real-time volume data acquisition, such as 4D ultrasound, the raw data is challenging to visualize directly without additional processing. Noise removal and feature detection are common operations, but many methods are too costly to compute over the whole volume when dealing with live streamed data. In this paper, we propose a visibility-driven processing scheme for handling costly on-the-fly processing of volumetric data in real-time. In contrast to the traditional visualization pipeline, our scheme utilizes a fast computation of the potentially visible subset of voxels which is an amount of data required to process. As filtering operations modify the data values which may affect their visibility, our method for visibility-map generation ensures that the set of elements deemed visible does not change after processing. Our approach also exploits the visibility information for the storage of intermediate values when multiple operations are performed in sequence, and can therefore significantly reduce the memory overhead of longer filter pipelines. We provide a thorough technical evaluation of the approach and demonstrate it on several typical scenarios where on-the-fly processing is required.

Towards Clinical Deployment of Automated Anatomical Regions-Of-Interest
Lindholm, Stefan; Forsberg, Daniel; Ynnerman, Anders; Knutsson, Hans; Andersson, Mats; Lundström, Claes

The purpose of this work is to investigate and improve the feasibility of automatic selection of ROIs in clinical volume rendering. In particular, this work evaluates an Automatic and Anatomical ROI (AA-ROI) approach based on the combination of automatic image registration (AIR) and distance-based Transfer Functions (DBTFs), designed for automatic selection of complex anatomical shapes without relying on prohibitive amounts of interaction. First, discussions were conducted with radiologists, resulting in a set of requirements that are critical for Direct Volume Rendering applications to be utilized in clinical practice. Following this, a prototype AA-ROI implementation was developed to address these requirements. Finally, the feasibility of the developed approach was assessed through a study where five radiologists interacted with the proposed methodology. The results highlight the potential of the proposed approach to improve efficiency in time-critical settings for cases with complex ROIs, but also that their clinical feasibility is conditional with respect to the radiologists trust in the registration process and its application to the data.

Keynote
Visual Computing in Healthcare – from the Research Lab into the Hospital
Nigel John
Bangor University, UK

Prof Nigel John leads a specialist unit in Wales called the “Advanced Medical Imaging and Visualization Unit”, established in 2011 and funded by the Wales government. The unit employs eight computer science researchers who collaborate with clinicians from many different medical specialties to identify and implement visual computing solutions within a hospital. We have undertaken a wide variety of projects covering simulation of medical procedures for training, image analysis, intra-operative assistance, and anatomy education. In this talk Prof. John will present a few case studies from the unit’s project portfolio and discuss some of the challenges involved in deploying visual computing solutions in a hospital setting.

Image Registration and Data Reconstruction for Medical Interventions
Smit, Noeska; Klein Hanvenseld, Berend; Staring, Marius; Eisemann, Elmar; Botha, Charl; Vilanova, Anna

In medical imaging, registration is used to combine images containing information from different modalities or to track treatment effects over time in individual patients. Most registration software packages do not provide an easy to use interface that facilitates the use of registration. 2D visualization techniques are often used for visualizing 3D datasets. RegistrationShop was developed to improve and simplify the process of volume registration with 3D visualizations and simple interactive tools. RegistrationShop provides ways of creating meaningful visualizations and interactive rigid and non-rigid transformation tools can be used to manipulate the volumes during the registration pipeline. RegistrationShop provides immediate visual feedback for all the rigid transformation tools allowing the user to examine the current registration result in real-time. When this work, a 3D comparative visualization system is introduced, as well as a way of placing landmarks in 2D volumes. An evaluation was performed in which domain experts found that RegistrationShop has the potential to improve the registration process by providing instant visual feedback and interactive registration tools.

Misalignment Correction in Open Cone-Beam CT
Wień, Weimin; Zheng, Guoyan

In this paper we present a new core point based 2D-3D registration approach for a deformable transformation of a 3D volumetric template to a limited number of 2D calibrated C-arm image and show its application to a 2D-3D reconstruction of the proximal femur. In our approach, the 2D-3D registration is done with a hierarchical deformable b-spline 2D-3D registration stage followed by a regularized deformable b-spline 2D-3D registration stage. In both stages, a set of core points is formed to compute rigid transformations over the domain of the 3D volumetric template first. The deformable registrations are then driven by computing nonlinear deformations of these control points with intensity-based 2D image registrations of C-arm images with the associated digitally reconstructed radiographs (DRRs), which provides the necessary information for registering the 2D images of the DRRs. The nonlinear deformations of the core points is computed using the 3D deformable b-spline registration. Finally, the results are given, which demonstrate the efficacy of the proposed approach. Quantitative and qualitative evaluation results are given, which demonstrates the efficacy of the proposed approach.

Visual Computing for Biology and Medicine
eight volunteers we achieve automatic reconstruction and registration without any user interaction, assess the context, and joint mono- and multi-modal registration. In an evaluation on 4D US sequences and MRI scans of including robust image-based ultrasound tracking, a novel learning-based global initialization of the anatomical error addressed, including reconstruction drift, anatomical deformations, vascular appearance alteration, and imaging artifacts. In this work, we present a fully automatic system including robust image-based ultrasound tracking, a novel learning-based global initialization of the anatomical context, and joint mono- and multi-modal registration. In an evaluation on 4D US sequences and MRI scans of eight volunteers we achieve automatic reconstruction and registration without any user interaction, assess the registration errors based on physician-defined landmarks, and demonstrate realtime tracking of free-breathing sequences.

Visual Explanations and Display Techniques
14:15 - 15:35
A Comparative User Study of a 2D and an Autostereoscopic 3D Display for a Tympano-plastic Surgery
Baer, Alexandra; Huebler, Antje; Saalfeld, Patrick; Cunningham, Douglas; Preim, Bernhard

This paper presents the design and execution of a comparative experimen- tation between participant study with 42 participants. We investigated depth perception comparing a 2D display with a glasses-free 3D autostereoscopic display. In total, we conducted a follow-up study with the new 3D display technology including a stylus as input device. This work comprises the design and technical validation of a prosthetic feature that is to be used to perform a "prosthesis fitting task". Participants had to position a prosthesis implant to reconstruct the osseous chain and thus a patient's hearing ability. The study revealed an overwhelming support of the 3D autostereoscopic display compared to a 2D display regarding depth judgment, task completion time and the number of required scene and prostheses interactions.

Interactive Visualization of Muscle Activity During Limb Movements: Towards Enhanced Anatomy Learning
Bauer, Armelle; Paclet, Florent; Cahouet, Violaine; Dicko, Ali-Hamadi; Palombi, Olivier; Faure, François; Troccaz, Jocelyne

We propose a framework to investigate a new way to learn musculoskel- etal anatomical kinematics using interactive motion capture and visualiza- tion. It can be used to facilitate the learning of anatomy by medicine and sport students, and for the general public. We study the impact of visual feedback on the learning and retention of anatomy in action. We illustrate our approach using the example of knee flexion and extension by visualizing the knee muscle activation prediction with agonist and antagonist co-contraction. Muscle activation data for specified movements is first measured during a preliminary phase. The user is then tracked in real-time, and its motion is analyzed to recognize the motion being performed. This is used to efficiently evaluate muscle activation by interpolating the activation data stored in tables. The visual feedback consists of a user-specific 3D avatar created by deforming a reference model and animated using the tracking. Muscle activation is visualized using colored lines of action or 3D meshes. This work was made possible by the collaboration of three complementary labs specialized in computer-aided medical interventions, computer graphics and biomechanics. Keywords: Anatomy Learning, Biomechanical Simulation, Real-Time, Augmented Reality, Embedding, Motion Capture and Reconstruction.

Survey of Labeling Techniques in Medical Visualizations
Oeltze-Jafra, Steffen; Preim, Bernhard

Annotations of relevant structures and regions are crucial in diagnostics, treatment planning, medical team meetings as well as in medical education. They serve to focus discussions, present results of collaborative decision making, record and forward diagnostic findings, support orientation in complex or unfamiliar views on the data, and study anatomy. Different techniques have been presented for labeling the original data in 2D slice views, surface representations of structures extracted from the data, e.g., organs and vascular systems, and data representations of 3D reconstructions of the data. All aim at a clear visual association of labels and structures, visible and legible labels, and a fast and aesthetic labeling while considering individual properties of the data and its representation and tackling various issues, e.g., occlusion of structures by labels, overlapping labels, and crossings of lines connecting labels with structures. We provide an overview of the existing medical labeling work and propose a classification with respect to the employed labeling technique. Furthermore, we give guidelines for choosing a technique dependent on the data representa- tion, e.g., surface renderings or slice views, the type of structures to be labeled, and the individual requirements on an effective label layout.

Force Sensitive Embedded Glove to Measure Axial Needle Forces with a Case Study for Transperineal Prostate Biopsies
Edwards, Marc R.; John, Nigel; Llyr ap Cenydd; Shergill, Iqbal

Automated ROI Placement in High-Resolution Radiographs of Calcaneus
Enkhabayar, Asura; Norman, Benjamin; Ljuhar, Richard; Hladůvka, Jiří

CellUnity, an Interactive Tool for Illustrative Visualization of Molecular Reactions
Gehrer, Daniel; Le Muzic, Mathieu; Viola, Ivan

Illustrative Visualization of Biochemical Processes Featuring Multiple Temporal Scales
Le Muzic, Mathieu; Parulek, Julius; Waldner, Manuela; Viola, Ivan

Surface-Based Visualization of Human Face Variation
Chaláš, I.; Ferková, Z.; Urbanová, P.; Kozlíková, B.; Kotulanová, Z. and Sochor, J.

Evaluation and comparison of Hessian-based enhancement methods for segmentation of 3D confocal microscopy images of adult Dros- ophila brains
Novikov, Alexey A.; Trapp, Martin; Tirian, Laszlo; Bühler, Katja

Real-time Simulation of Peripheral Nerve Stimulation for Regional Anaesthesia
Ding, Yi; Pop, Serban; Vidal, Franck; John, Nigel

FACTS – Fully Automatic CT Segmentation of a Hip Joint
Chu, Chengwen; Chen, Cheng; Liu, Li; Zheng, Guoyan

Metacarpal Thumb Joint Measurement and Rehabilitation with LeapMotion
Edwards, Marc R.; John, Nigel; Jesudason, Edwin
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