IT'IS FOUNDATION

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Draft

SPARC SIM-Core Questionary to SPARC Teams

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Notations

- ***(DC)*** : Question of interest to SIM-CORE that primarily concerns DAT-CORE
- ***(MC)*** : Question of interest to SIM-CORE that primarily concerns MAP-CORE
- *(DC)* : Question of interest to SIM-CORE that also concerns DAT-CORE
- *(MC)* : Question of interest to SIM-CORE that also concerns MAP-CORE
- **bold**: Key question

Questionary

Data Generation: overview

1. ***(DC)*** What kind of data will your team produce (image data - e.g., anatomical, nerve cross sections, calcium, two photon microscopy, segmentation - , histological data, nerve trajectories, electrophysiological recordings, electrophysiological axon/nerve models, connectome, neuronal networks, 3D neuronal morphologies, optogenetic data, anatomical models . . .)?

2. ***(DC)*** Which formats / sizes will this data take? ***(MC)*** Metadata?

3. ***(DC)*** Will there be any privacy concerns related to these data and their use?

4. ***(DC)*** Is industry involved in data acquisition? If yes, in which way? Are there potential conflicts of interest, patents pending, confidential information? Will the data be immediately available after generation or will it be subject of embargo? If embargo, when the data could be available?

5. ***(DC)*** Can the data be used right away or does it need to be processed/analyzed? If yes, what is the effort/time required? Is this an automatic step or does it require manual work?

6. Is your data generation aimed at producing reference databases (e.g. statistical information about fiber types and distribution, tissue properties, etc.) that could be readily used for computational modeling?

7. ***(DC)*** */(MC)* What animal species have been used to obtain data?

Modeling: General

1. *(DC)* */(MC)* Is your group expected to produce/contribute in producing a computational model from your research? **If yes, which are the key ingredients of your model** (electrophysiology, 3D organ anatomy, 3D neuronal morphology & anatomical connectivity, functional connectivity maps, histological data, biophysical parameterization, neuronal network, electro-mechanical model (e.g. cardiac or breathing), neuro-target junctions, etc.)?

2. *(MC)* **Which aspects of your model could benefit if it become possible to embed it into the local or full anatomy?**

3. How far is your model from being useful in the context of precision/personalized medicine?

4. *(MC)* Are you making use of some standardized formats/coupling descriptors. . . ?

5. Would you benefit from cloud-based simulations? Postprocessing?

Modeling Organ Anatomy, Nerve Trajectories, Connectomes

1. *(MC)* **What species will you be studying/modeling?** What forms of anatomical variability are important to you (e.g. specific BMI, age, etc)?
2. Do you need/plan to use/would you have large benefit in using the SIM-CORE segmentation functionality to produce 3D models from image data?
3. *(DC)* **If yes, what kind of image data do you want to segment (CT, MRI, microscopy, DTI...)? Into how many distinct tissues / at what level of detail?** Will you segment microscopic/macroscopic images?
4. *(MC)* **Would you derive nerve (axonal) trajectories and connectomes? Do you need nerve microanatomy?**
5. *(MC)* Do you envision anatomical modeling based on personalized/individual data, or based on statistical/population distributions & parameters?
6. Are the generated models specific or can they be parameterized/generalized? If yes, which sort of parameterization/adaptation is require to account for variability?
7. *(MC)* **Are your models suited to be integrated into an anatomical reference environment** (do they have a clear spatial localization in the anatomical space)?

Modelling & Simulating Neuronal Electrophysiology

1. If the model includes a neuronal electrophysiological part, **what is its extent and complexity** (large assembly of independent axons, interconnected neurons, small-large neuronal network, simplified representation e.g. integrate & fire; how many neurons need to be simulated, duration, frequency...)? Do you need parallelized neuron simulations (technique, scaling)?
2. *(MC)* **What kind of neuronal modeling approach do you use** (e.g. cable equation, integrated neural mass models, etc.)? What software do you use (NEURON, GENESIS, etc.)? Do you require standard types of neuronal dynamics models (which)? Will you get models from standard repositories (such as the ModelDB)?
3. *(MC) /(DC)* Do you also electrophysiologically characterize the reconstructed neurons (individuate and quantify ionic channel distribution and types, membrane properties, etc.) and reconstruct complete electrophysiological models?
4. Do the reconstructed electrophysiological model represent a good statistical template of neuronal population? Is sensitivity analysis performed?
5. *(MC) /(DC)* Have / will the electrophysiological models be(en) validated with experiments? Which ones?
6. *(MC)* **Are network properties important** in characterizing electrophysiology? Is the (organ-)system-specific neuronal connectome known? If you investigate neural networks, **which are the key neuronal types and connections (synaptic...) involved?**
7. Is the modelling of axons/neuronal terminals (receptors, neuro-muscular junctions, etc.) necessary/important/fundamental to predict function (mechanical, chemical, etc.)? How are they modelled?
8. *(DC) /(MC)* Do you acquire and reconstruct neuronal morphologies from images? In which format are the morphologies stored? Are the morphologies available in online model repository (such as NeuroMorpho, CVapp, etc.)?
9. How important is it to model recording (e.g. predict compound action potentials, extracellular fields, etc.)?
10. *(MC)* Is the created electrophysiological/neuronal network model valid for other species? Which ones?

Coupling Electrophysiology & Multiphysic Simulations

1. **Do you (plan to) use multiphysic simulations coupled with electrophysiological models of neurons** to investigate the effect of therapeutical treatment (e.g. electroceuticals) on organ functionality?

2. **What technology (FEM, ODE...)? What kind of requirements (size, computational effort)? What kind of HW environment** do you need to execute these models (computational power, number of processors/CPU time, GPU)?

3. **What approach do you use to develop your models** (Python, MATLAB/OCTAVE, stand-alone executable, ...; CellML/SBML, NEURON...; operating system)?

4. *(MC)* **What input do these models take (type, size)? What form of neural I/O** (transient trans-membrane potential (V), spiking frequency, connection strengths? populations of fibers...)?

5. *(MC)* **What is your coupling approach (pipelining/iterative/multiscale) (time, space)? How heavy is the communicated data/frequent is the exchange?**

6. **Will you need to model forms of stimulation? EM (electrode, coils)/acoustic (transducers)/mechanical, etc.? Do you need physical modeling for this? What are the relevant features (frequency, anisotropy, thin layers, contacts...)?**

7. *(DC)* What form of model V&V/certification do you foresee for models you create yourself (MMF, experimental, external experts...)?

8. Will simulations be used to control/design/optimize devices or therapies? ***(DC)*** Could there be a closed loop control involving experimental measurements (real-time requirements)?

9. *(DC)* If you have experience in modeling, how many different software are currently necessary to complete your full investigation (including data post-processing, model generation, multi-physics solvers, post-processing, etc.)? Where would you benefit from interfacing different steps within one single framework?

10. *(DC)* Which is currently the most time-consuming step in your pipeline? Why? What would help you?

11. Do you envision that the results of your models could help to reduce the use of animal experiments in the future?

Online Platform: User Perspective

1. **Are you likely to make use of a platform scripting interface?** For modeling, simulation, analysis? Will you share your scripts?

2. **How frequently/heavily do you plan on using the simulation platform?** Are you likely to perform simulations involving models generated by other SPARC teams (and which ones)?

3. How many users you expect will be utilizing the platform in your group? How many simultaneously?

4. **How are your preferences about running simulations locally or in the cloud?** Do you use existing cloud services already (which ones, do you have an established form of job submission)?

5. What approach to (model) sharing will you take? Will you allow other to run your models/couple to them/modify them...?

6. How expensive can the service be for you to continue using it?

7. If you develop own models/services, what forms of licensing will you need (open source license/type, commercial licensing, access only to specific user-groups (e.g. SPARC))?

Postprocessing: Visualization and Analysis

1. *(MC) /(DC)* **What forms of visualization will you require** (3D anatomy, simulated fields, neural activity, maps, graphs...)? **How heavy are the visualized objects** (degrees of freedom, triangles...)
2. *(DC)* Is visualization of transients or time dependent data necessary (4D data)?
3. *(DC) /(MC)* Do visualization need to be interactive? Which level of interaction needed? (click-touch-drag, etc.)
4. Do visualization requires massive computing (e.g. use of GPU cards, etc?)
5. *(DC)* What sort of open-source post-processing software do you use/are familiar with?
6. **Do you plan to used modeling to perform sensitivity analysis, uncertainty assessment, optimization, inverse problem solving, machine learning, surrogate model generation? Electrode/stimulation optimization (e.g., of selectivity)?**

SPARC Team & IT Resources, Contribution to Development

1. What kind of IT resources and infrastructure do you have in your laboratory/institute (desktops, laptops, servers, operating systems) ?
2. How many people from your group have in depth IT expertise?
3. **Are you likely to implement own analysis/visualization/segmentation plug-ins?** Would you do that in Python, Javascript, C++, Matlab, etc.?
4. *(DC) /(MC)* **Are you likely to attend a training event (in person, per webinar...)?** What are the conferences you usually attend?
5. Are you likely to contribute to the platform open source development? In what way?

Projects-Specific Issues

1. **Do you have specific needs and issues that you feel have not been addressed by the previous questions?**
2. **Will you require a team that works with you on building models?**
3. *(DC) /(MC)* What are your main active collaborations with other SPARC teams?
4. Do you expect/foresee the use of the platform for the development of industrial applications?

Miscellaneous

1. *(DC) /(MC)* What kind of authentication mechanisms are expected? Should the platform visible to anyone? Do users need to request a login via SPARC?
2. *(DC) /(MC)* What kind of social media (Twitter, LinkedIn, FB, ResearchGate, etc.) would users like to link the platform with?