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**stubs**

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**GETTING STARTED:**

<b>1</b>	<b>Installation</b>	<b>3</b>
<b>2</b>	<b>Mathematics</b>	<b>5</b>
<b>3</b>	<b>Frequently Asked Questions</b>	<b>7</b>
<b>4</b>	<b>Python API Reference</b>	<b>9</b>
<b>5</b>	<b>Pystubs Test</b>	<b>11</b>
<b>6</b>	<b>Indices and tables</b>	<b>13</b>



STUBS is a biophysical simulation library that provides a level of abstraction to models, making it easier for users to develop, share, and simulate their mathematical models. STUBS is highly suited for building systems biology models and simulating them as deterministic partial differential equations [*PDEs*] in realistic geometries using the Finite Element Method [*FEM*] - the integration of additional physics such as electro-diffusion or stochasticity may come in future updates. Systems biology models are converted by STUBS into the appropriate systems of reaction-diffusion PDEs with proper boundary conditions. [FEniCS](#) is a core dependency of STUBS which handles the assembly of finite element matrices as well as solving the resultant linear algebra systems.



## INSTALLATION

Simply run `pip install fenics-stubs` in an environment with FEniCS installed. We recommend using a [FEniCS docker container](#) to minimize installation issues.





## MATHEMATICS

Mathematics related to stubs.

### 2.1 Multi-Dimensional Reaction-Diffusion Equations

Volumetric partial differential equations

$$\begin{aligned}\partial_t u_i^{(a)} &= \nabla \cdot (D_i^{(a)} \nabla u_i^{(a)}) + f_i^{(a)}(u^{(a)}) \quad \text{in } \Omega^{(a)} \\ D_i^{(a)} (\nabla u_i^{(a)} \cdot n) &= r_i^{(abc)}(u^{(a)}, u^{(b)}, v^{(abc)}) \quad \text{on } \Gamma^{(abc)}\end{aligned}$$

Surface partial differential equations

$$\begin{aligned}\partial_t v_i^{(abc)} &= \nabla_S \cdot (D_i^{(abc)} \nabla_S v_i^{(abc)}) + g_i^{(abc)}(u^{(a)}, u^{(b)}, v^{(abc)}) \quad \text{on } \Gamma^{(abc)} \\ D_i^{(abc)} (\nabla_S v_i^{(abc)} \cdot n) &= 0 \quad \text{on } \partial\Gamma^{(abc)}\end{aligned}$$



## FREQUENTLY ASKED QUESTIONS

1. How do I use pip to install stubs?

The name of the package is `fenics-stubs` which unfortunately does not match the module name. Run `pip install fenics-stubs`.



## PYTHON API REFERENCE

### Modules

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## **PYSTUBS TEST**

Testing more verbose documentation.

### **5.1 Testing explicit members**





## INDICES AND TABLES

- `genindex`
- `modindex`
- `search`