Computational steering: Interactive Design-through-Analysis

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SURF

TU Delft

SURF Open Innovation Lab

Explore technological innovations for education and research with focus on the challenges of the future

Innovation themes

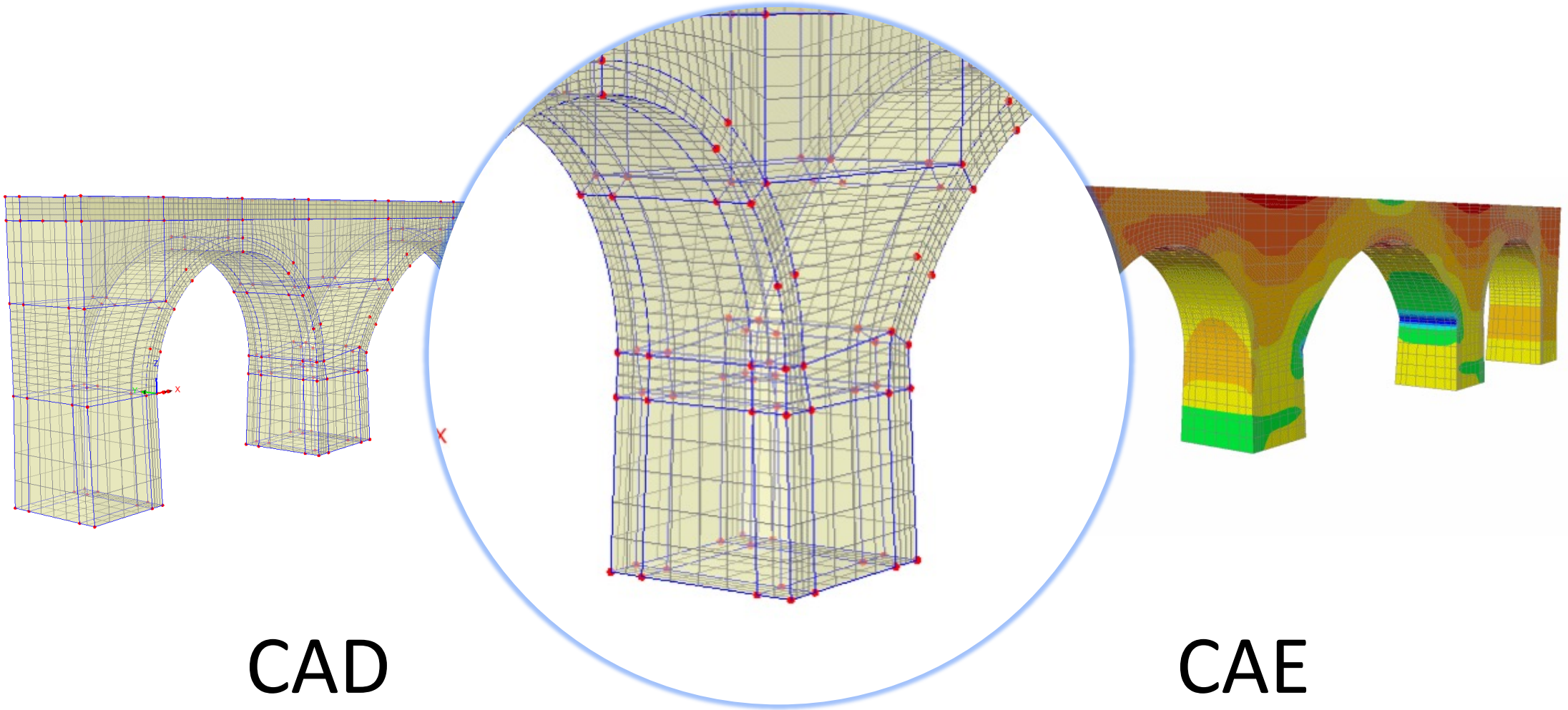
- Future computing & networking
- Edge-oriented technologies
- Data processing & data management technologies
- Artificial Intelligence


Design a
bottle


SUMMER
DRAFT


Design a
bridge

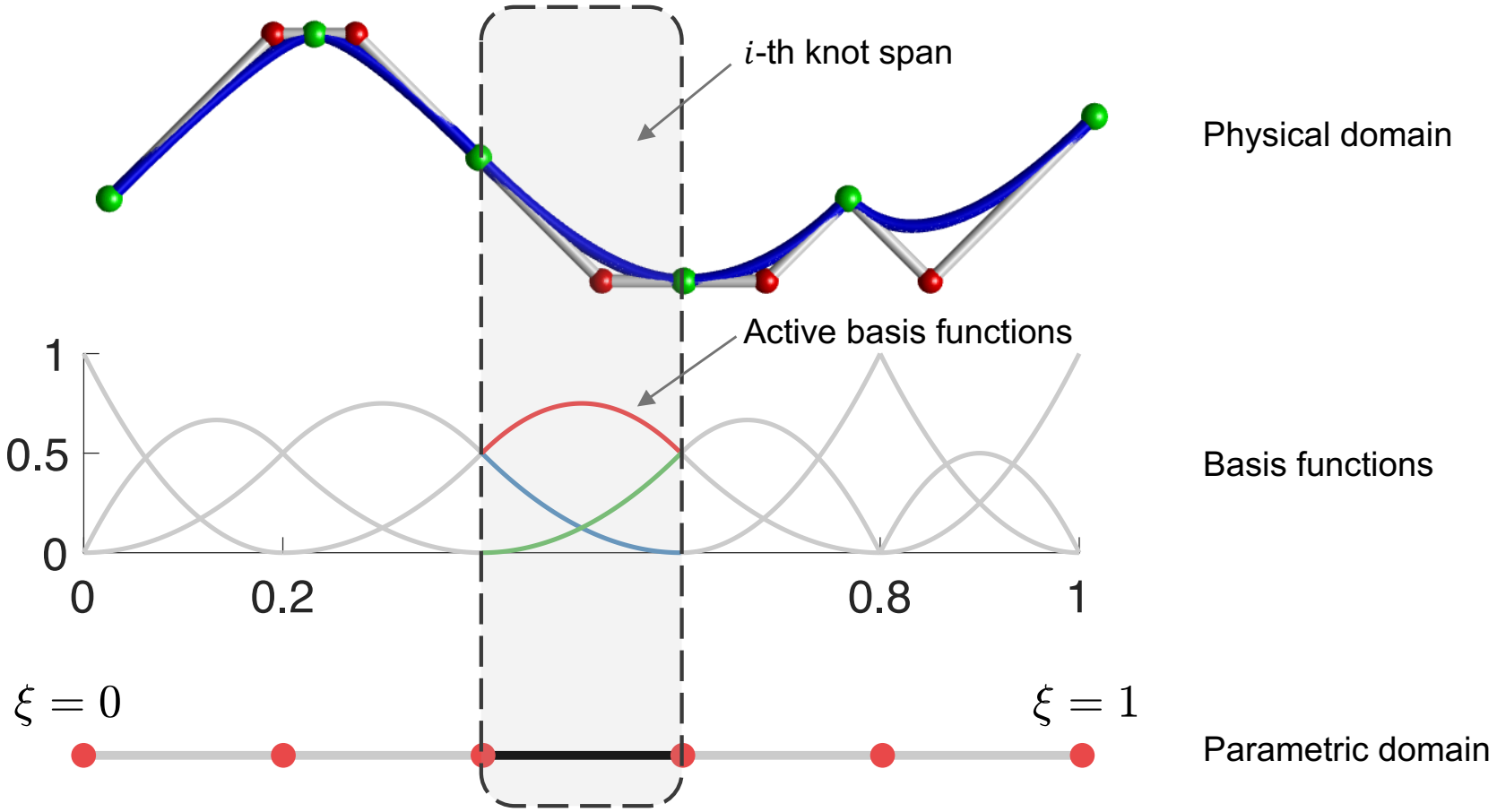
Design-through-analysis



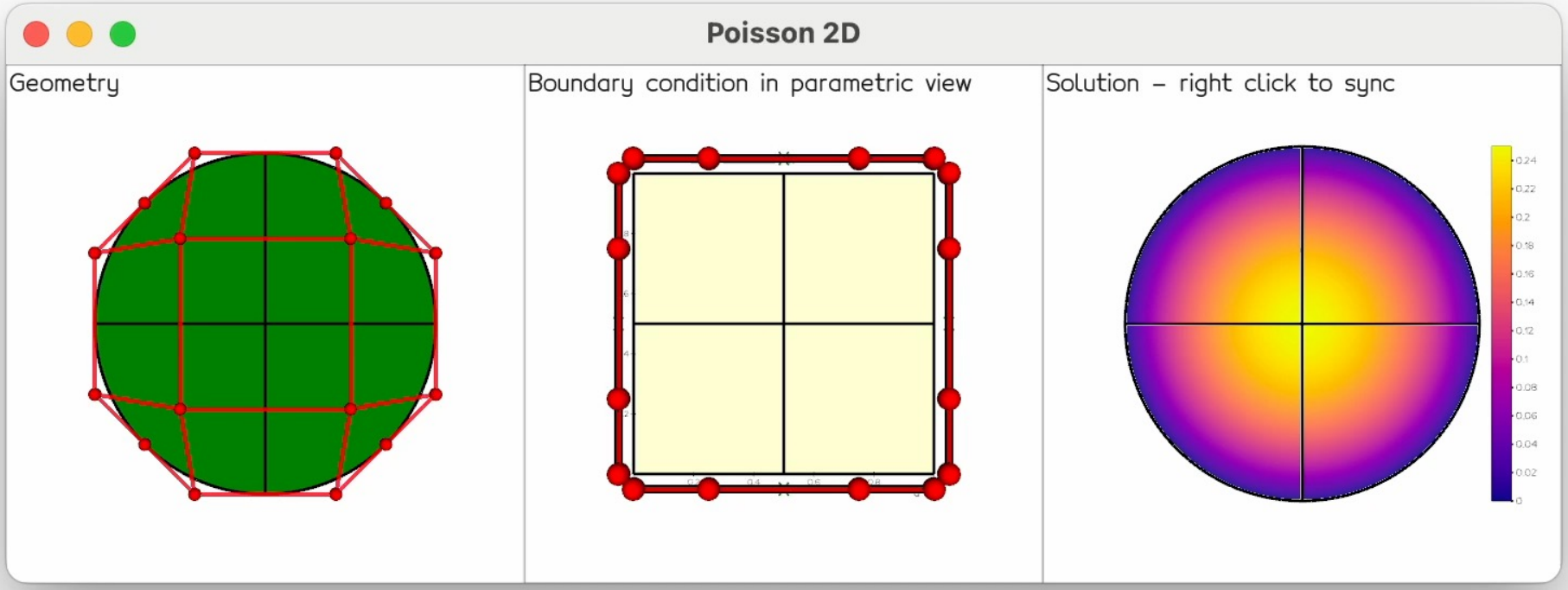
CAD

CAE

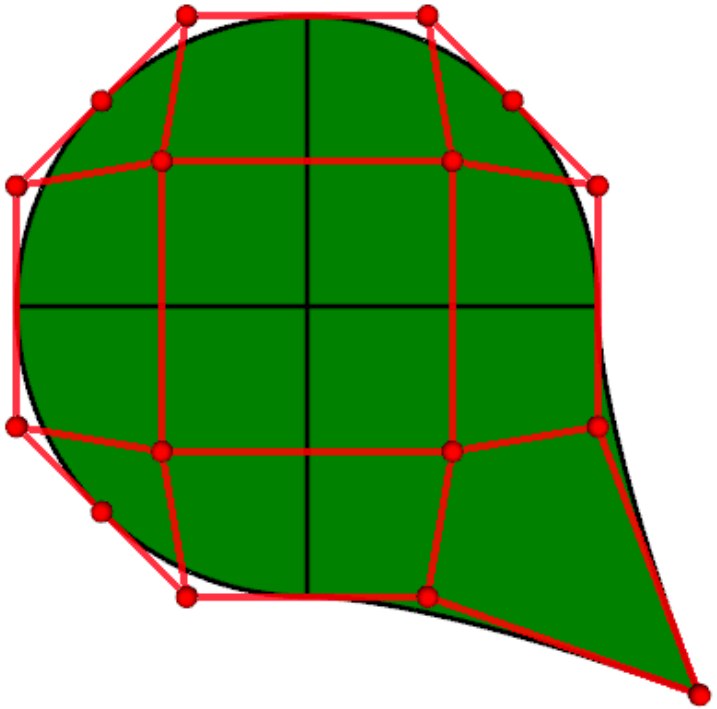
Spline curves $C(\xi) = \sum_{i=1}^{n} \boldsymbol{P_i} b_i(\xi)$



CAD + CAE with splines



The math behind it

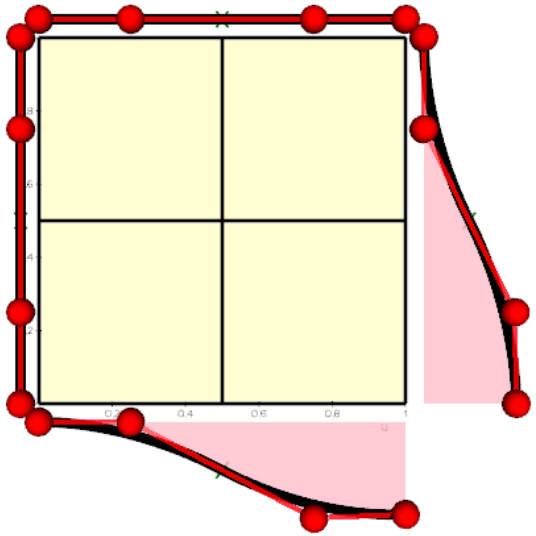


$$\boldsymbol{x}(\xi,\eta) = \sum_{i=1}^{n}\sum_{j=1}^{m} \boldsymbol{x}_{i,j} b_i(\xi) b_j(\eta)$$

The math behind it

$$u(\xi, 1) = \sum_{i=1}^{n} g_{i,m} b_i(\xi)$$

$$u(0, \eta) = \sum_{j=1}^{m} g_{1,j} b_j(\eta)$$



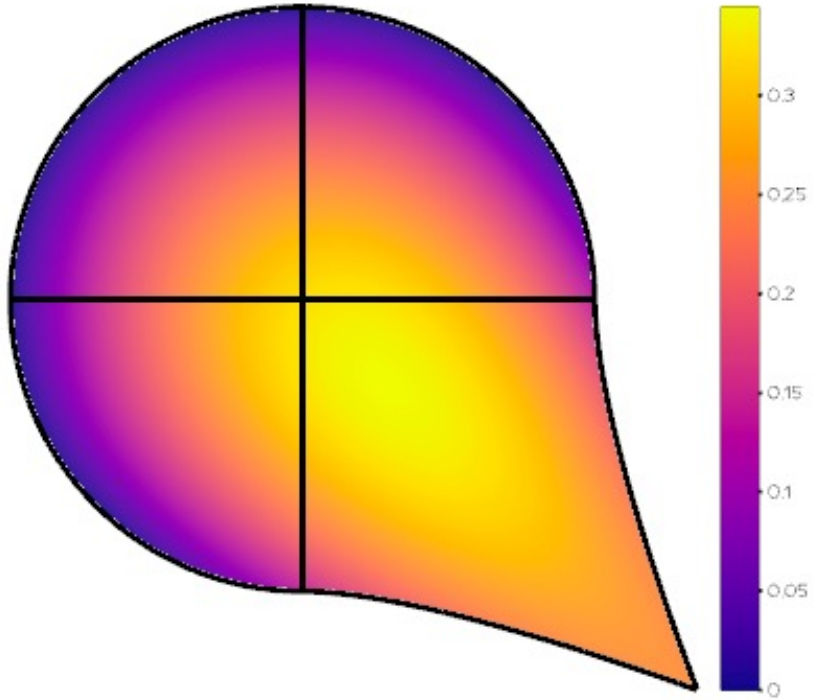
$$u(1, \eta) = \sum_{j=1}^{m} g_{n,j} b_j(\eta)$$

$$u(\xi, 0) = \sum_{i=1}^{n} g_{i,1} b_i(\xi)$$

The math behind it

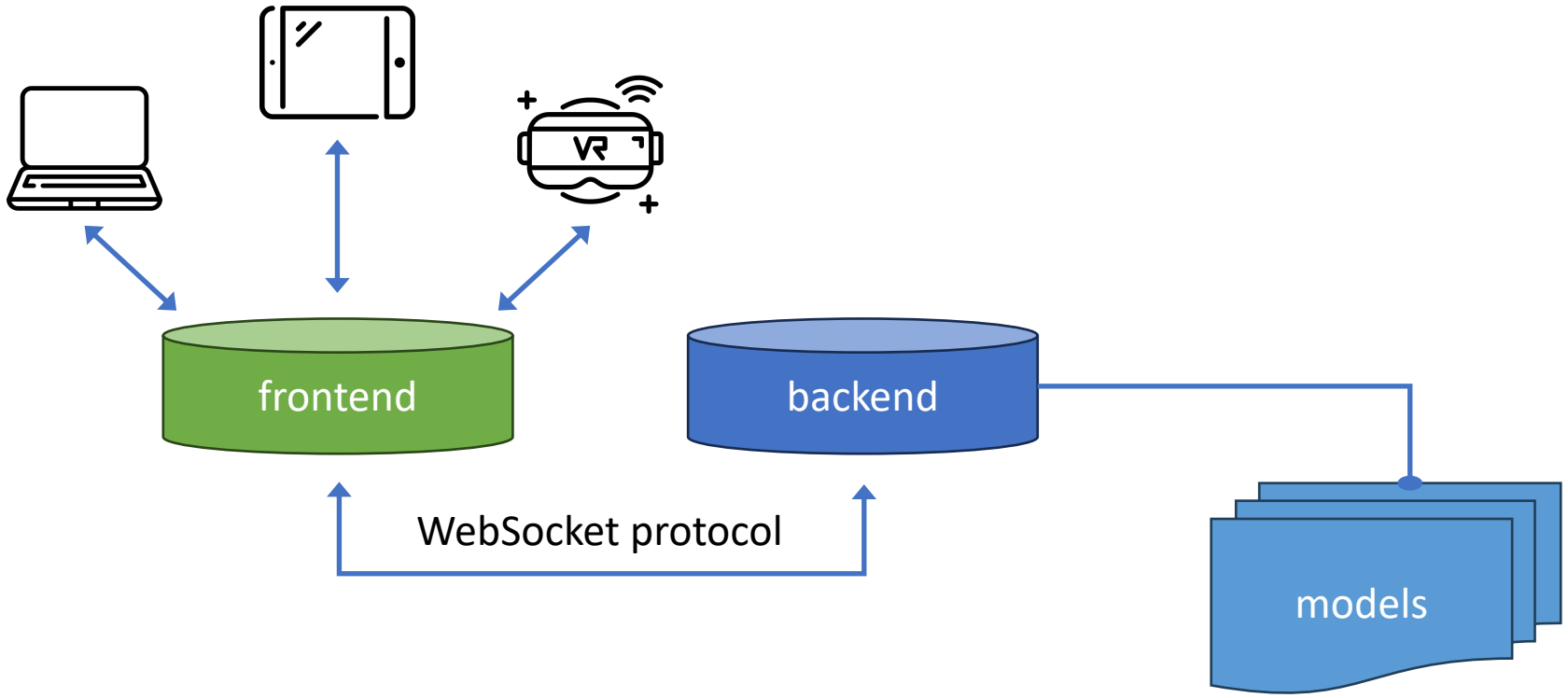
$$-\Delta u = f \text{ in } \Omega$$
$$u = g \text{ on } \Gamma$$

$Ax = b$

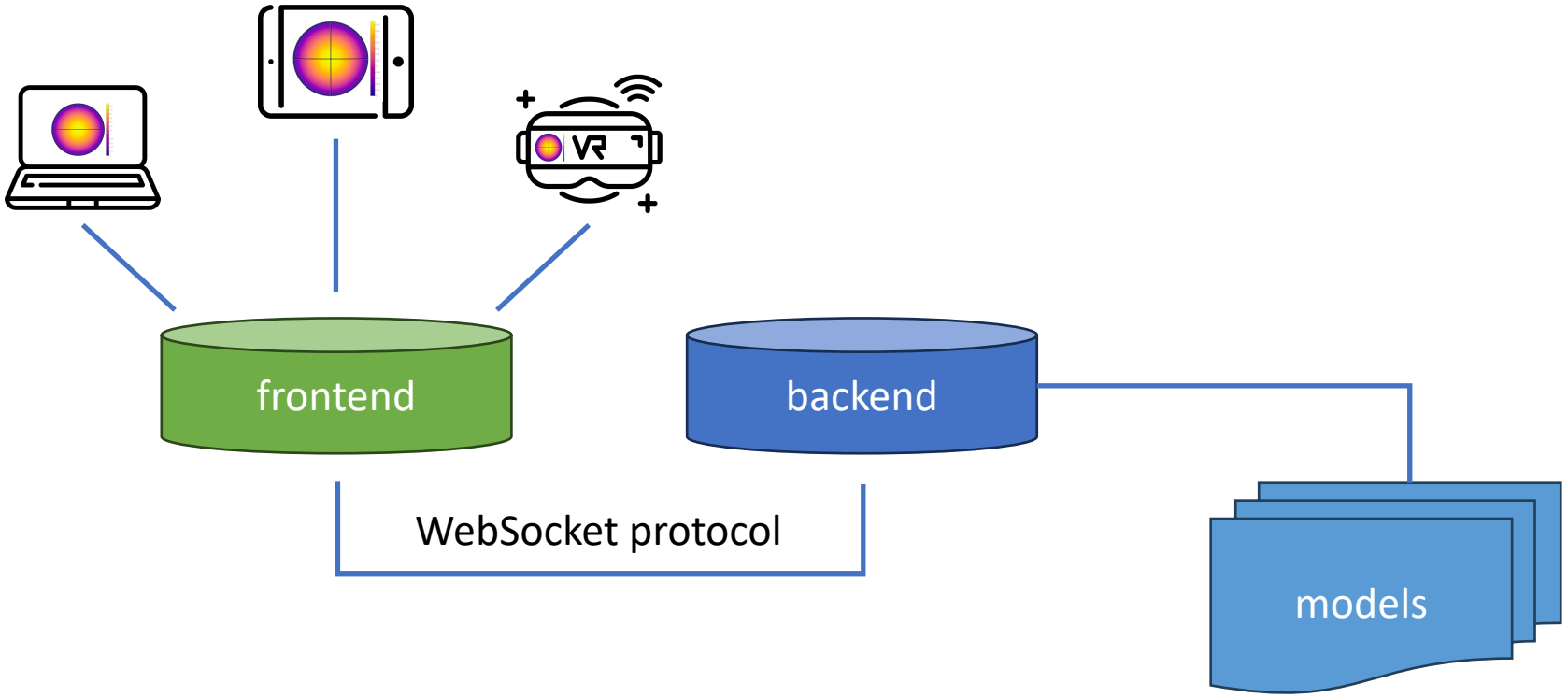


$$u(\xi,\eta) = \sum_{i=1}^{n}\sum_{j=1}^{m} u_{i,j} b_i(\xi) b_j(\eta)$$

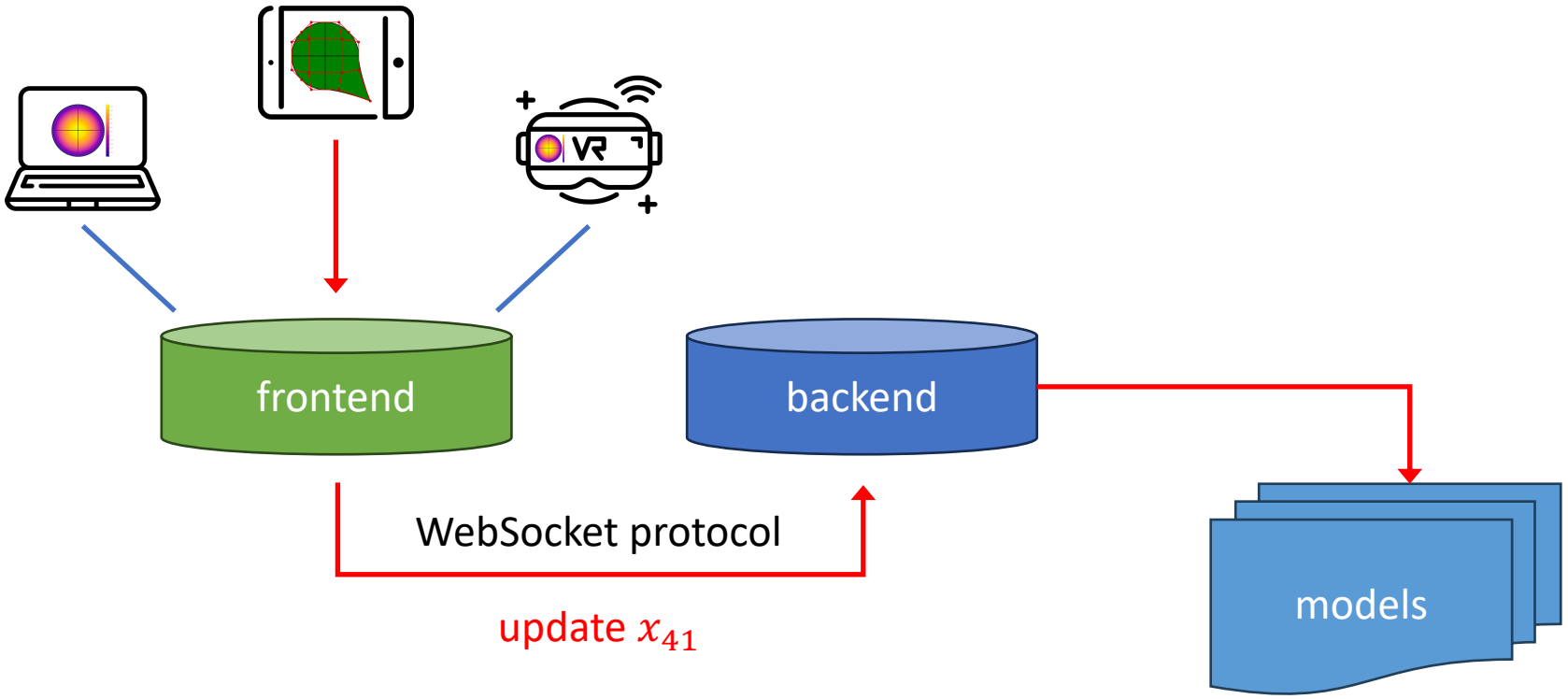
Collaborative DTA workflow



Collaborative DTA workflow

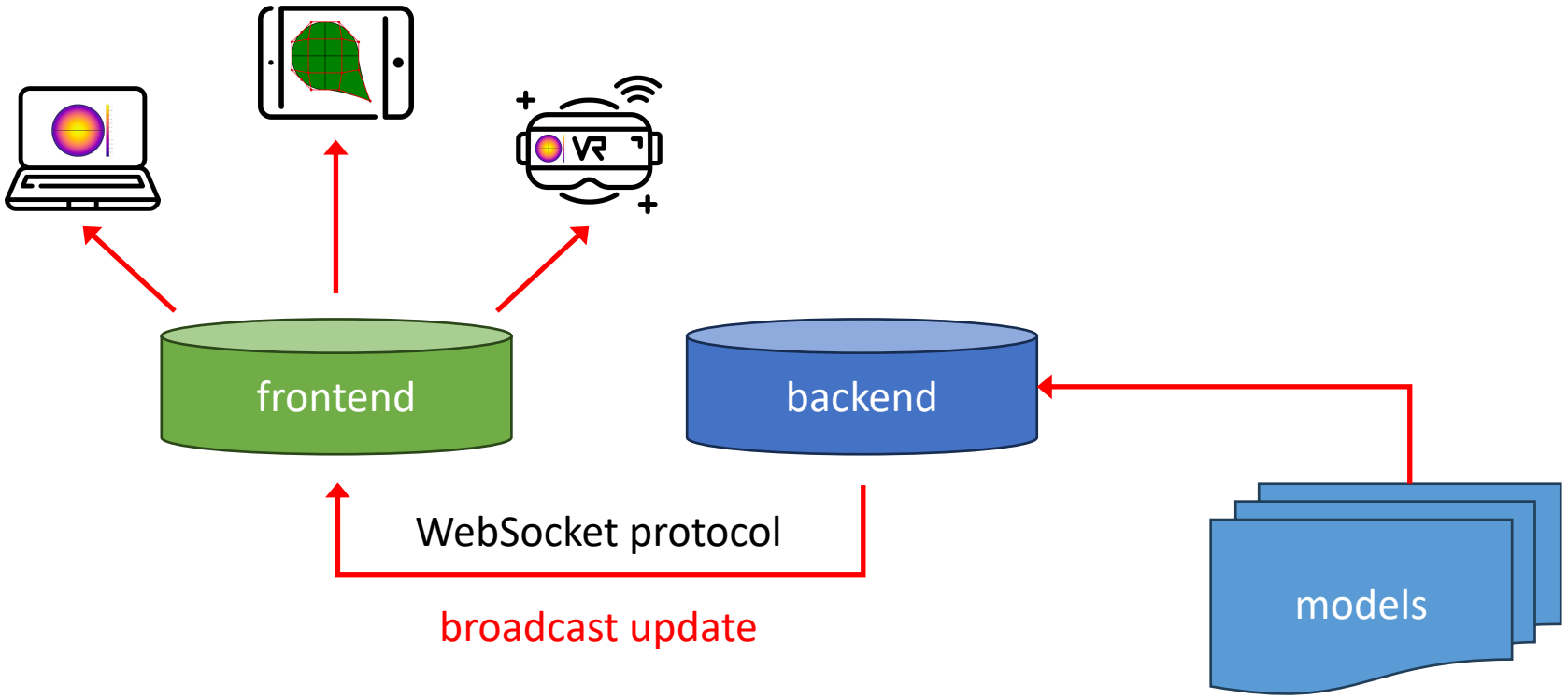


Collaborative DTA workflow

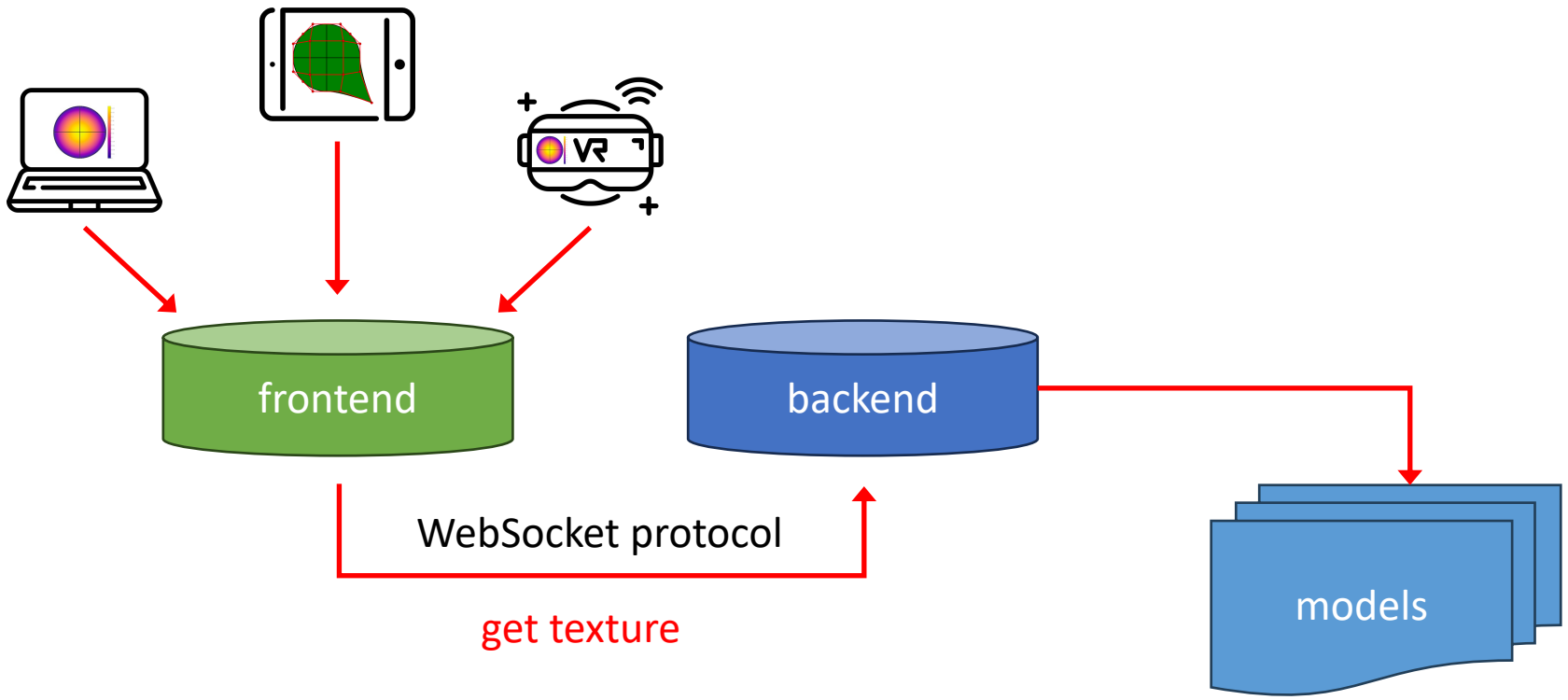


- update geometry
- update solution

Collaborative DTA workflow

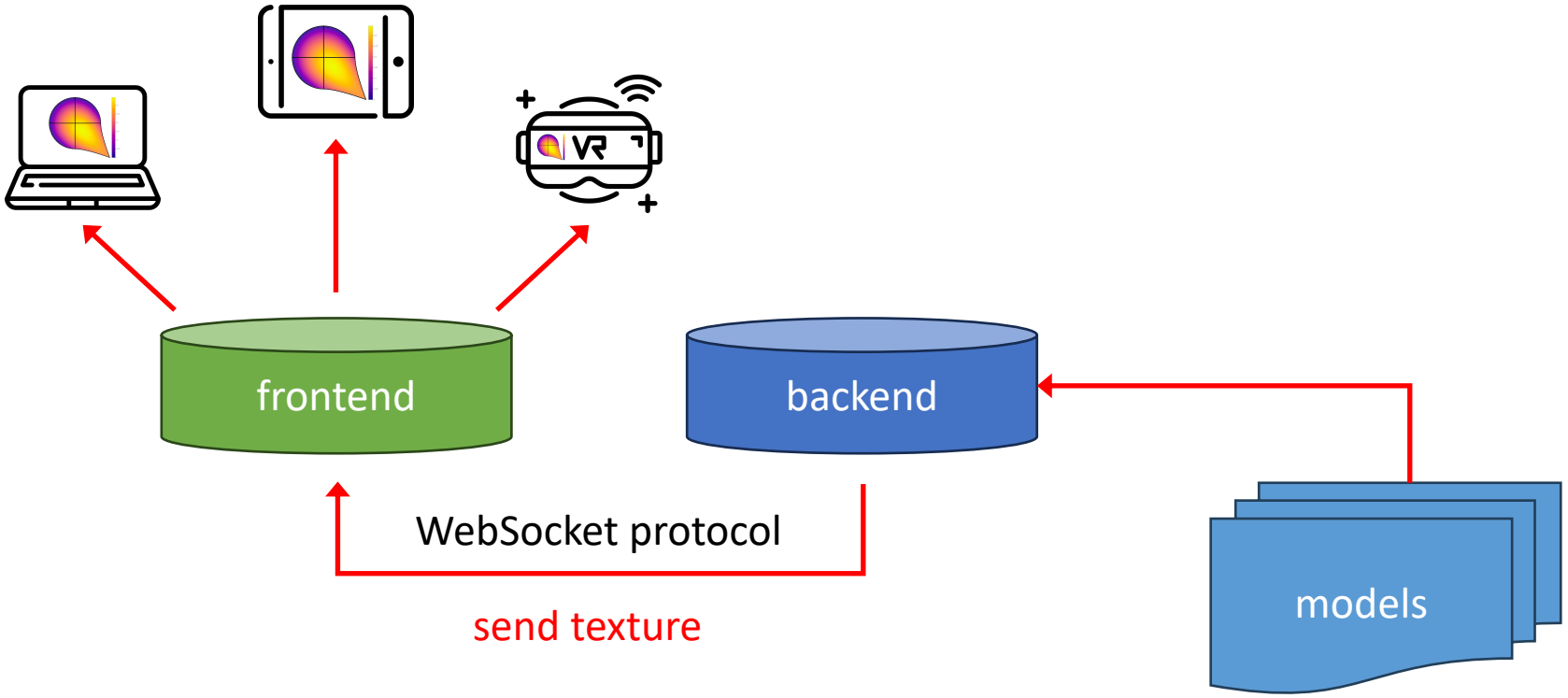


Collaborative DTA workflow



- create texture

Collaborative DTA workflow



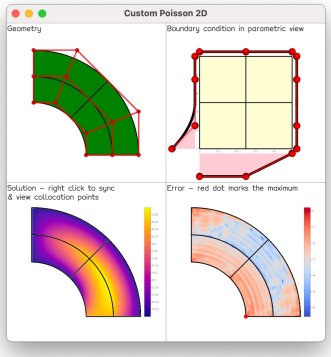
Collaborative DTA workflow

C++17 threads
μWebSockets

frontend

backend

Python



WebSocket protocol

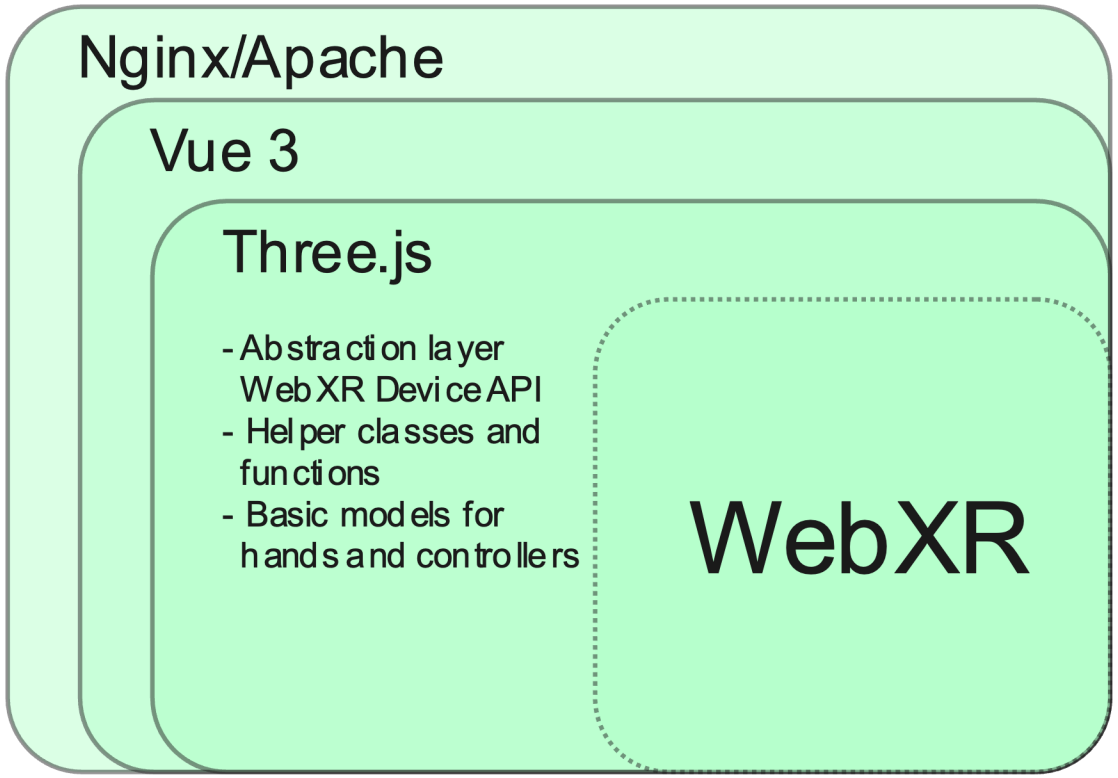
models

Dynamic libraries

IgANet

WebXR implementation

Our implementation:



Possible other solutions:

- Babylon.js (low-code editor)
- PlayCanvas (free public, paid private low-code editor)
- A-frame (HTML-document style)

Live demo