MATLAB

2D Modellierung
Wärmeleitung

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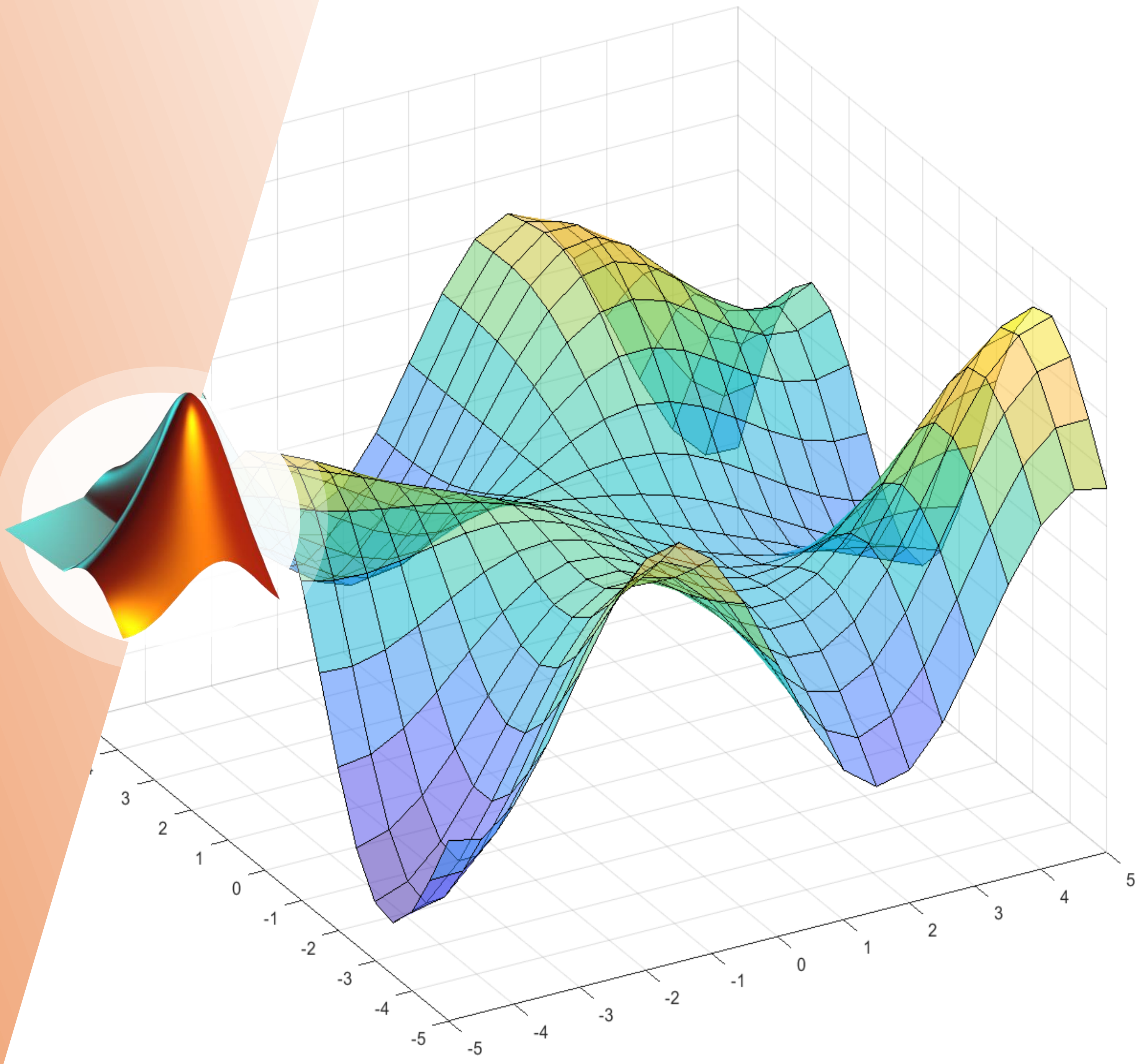
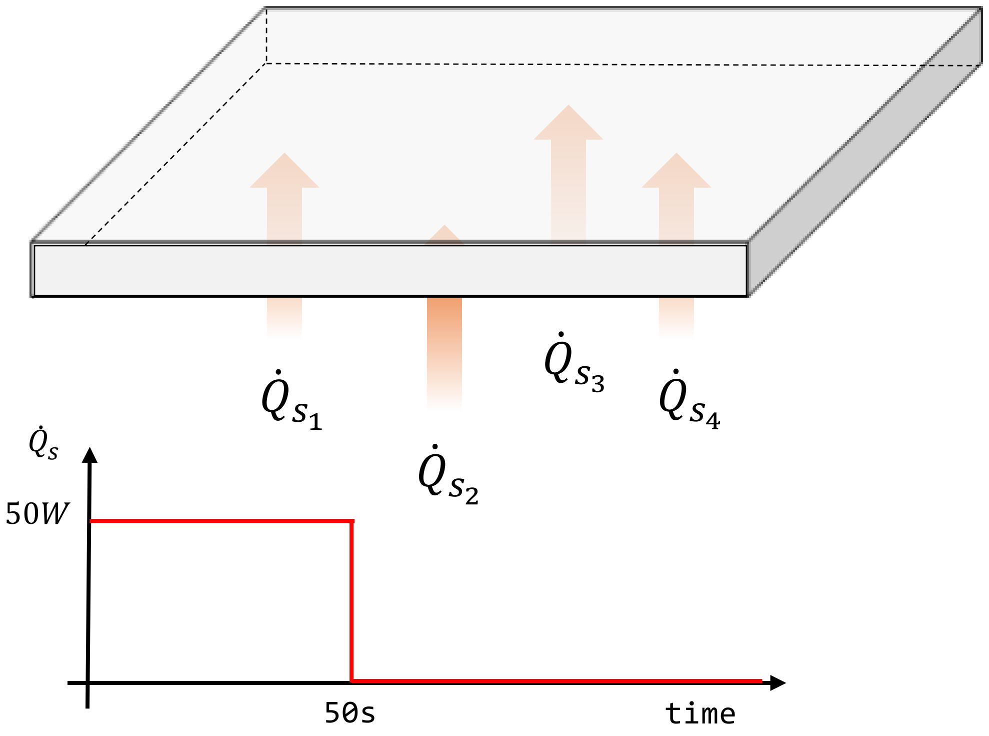
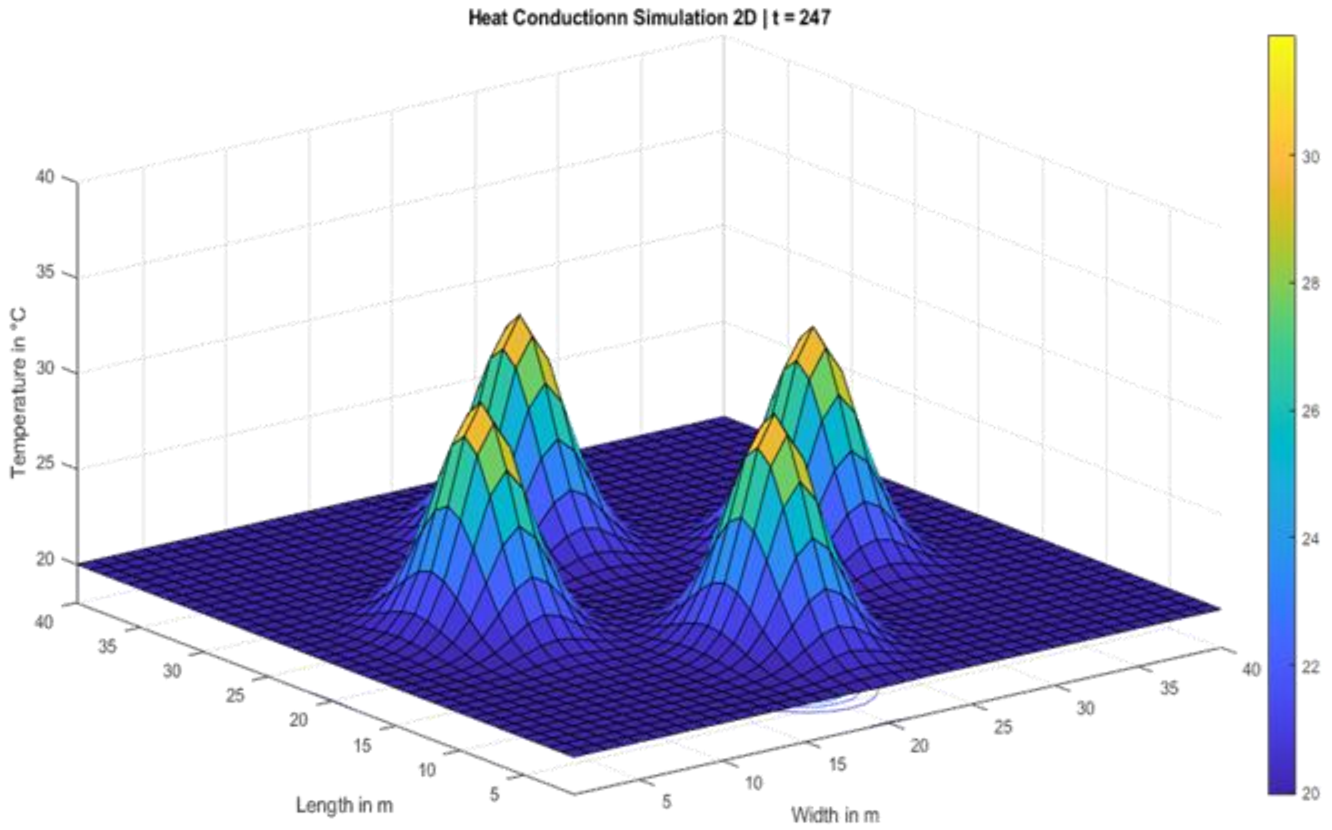
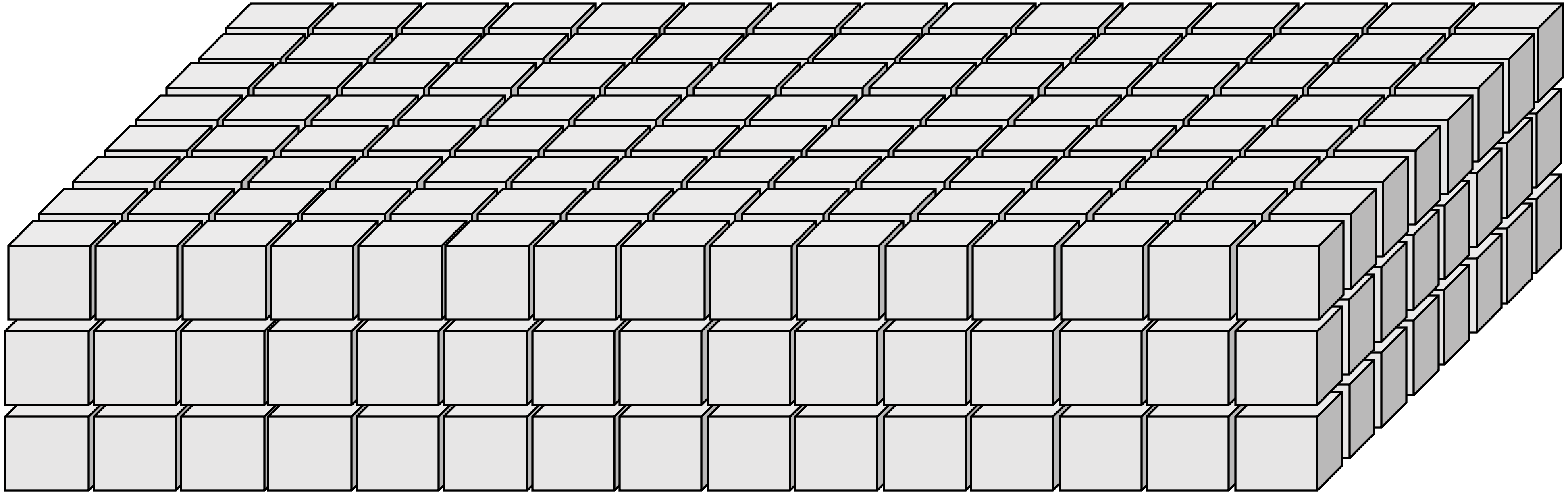


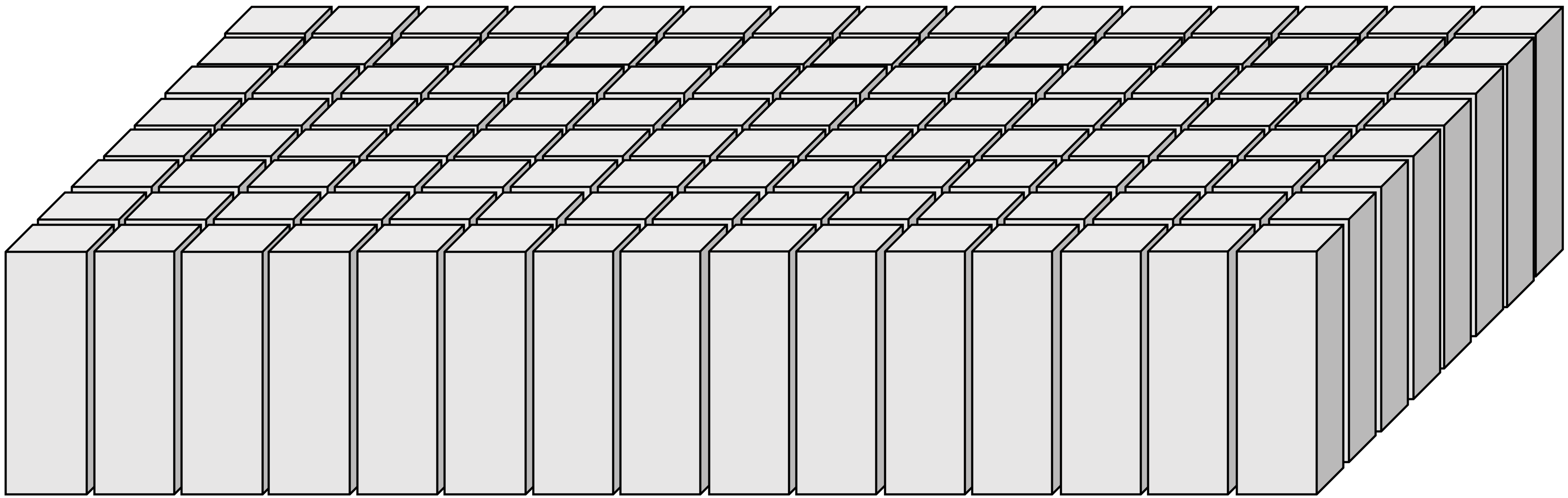
DHBW Stuttgart

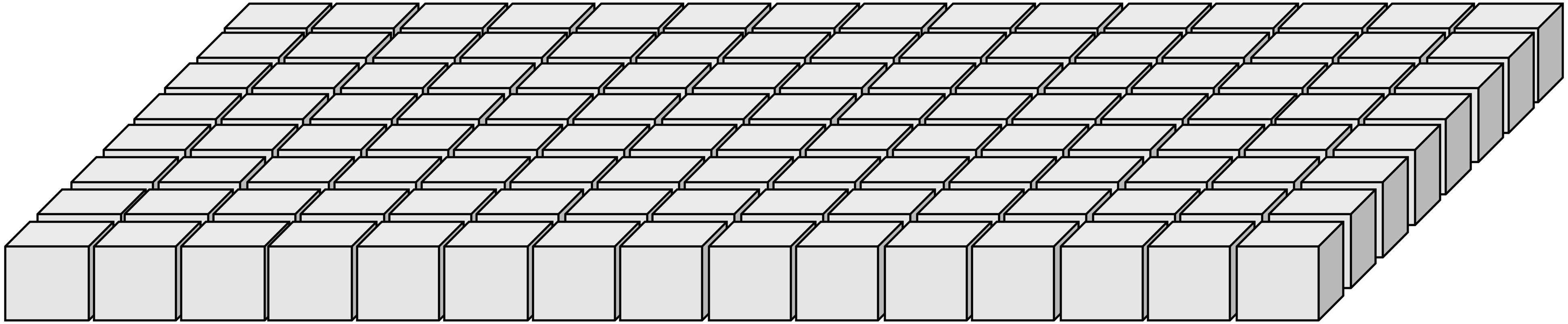
temperature distribution in the plate?

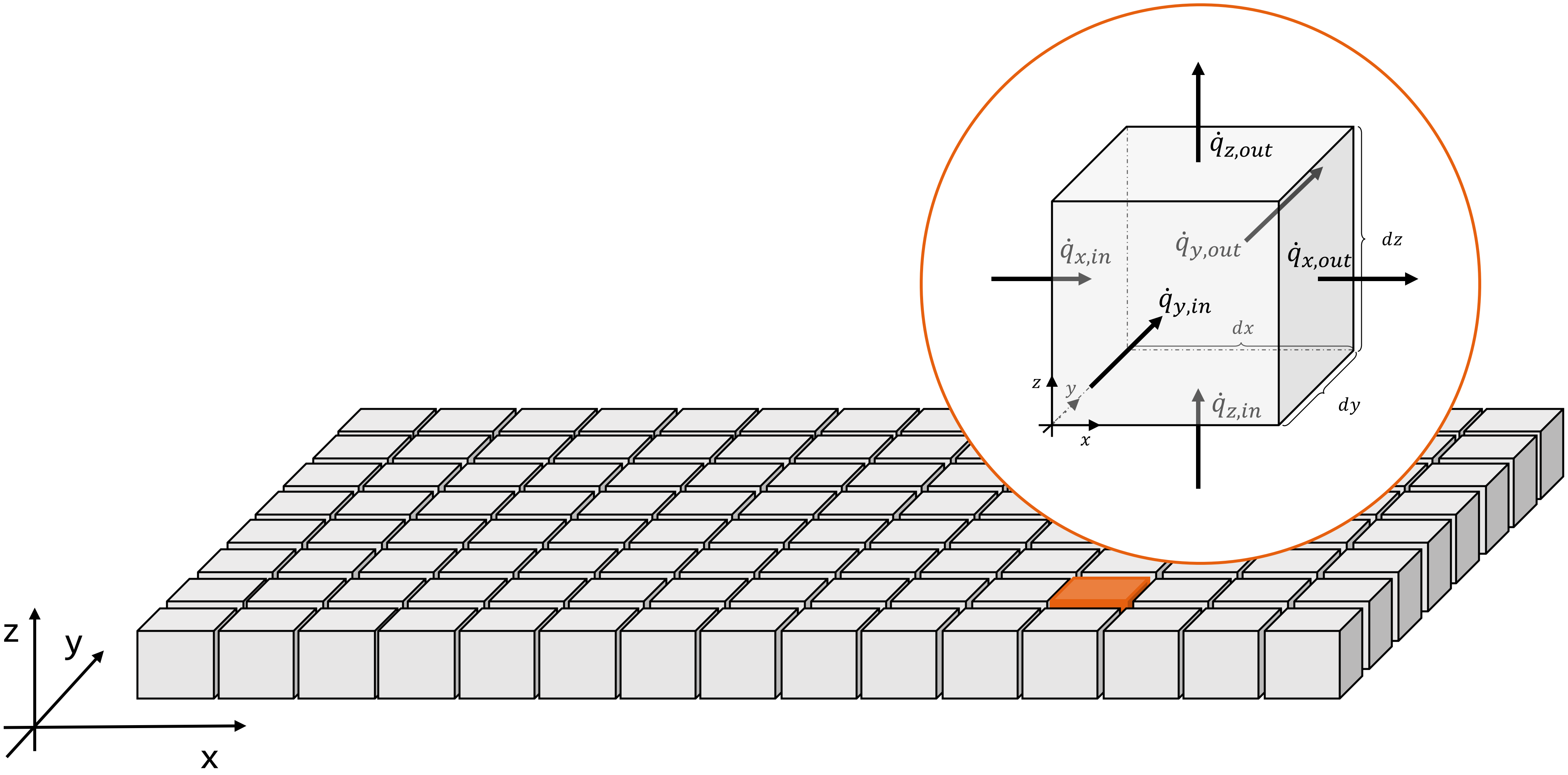


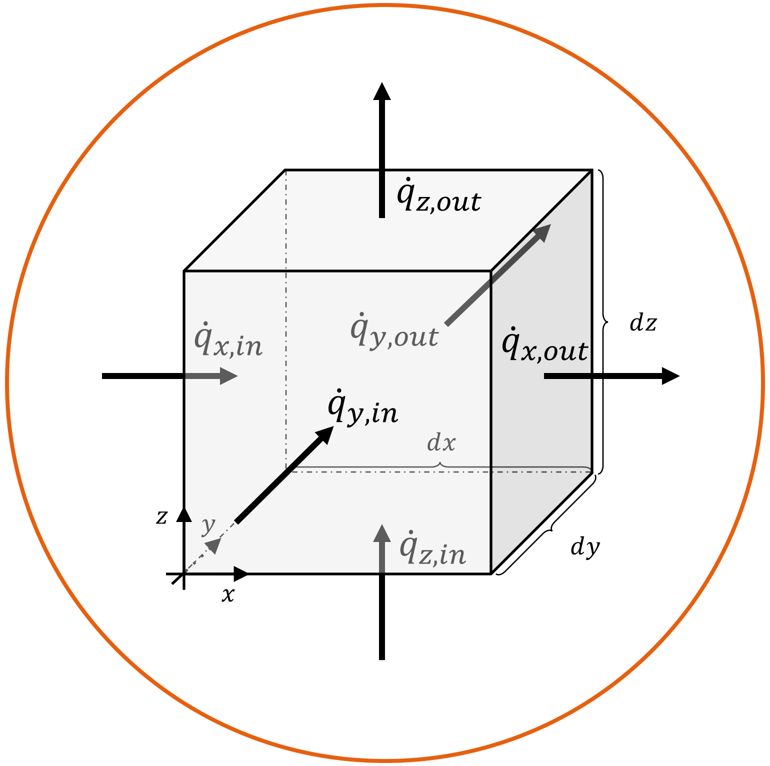









$\dot{q}_{z,out}$
$\dot{q}_{x,in}$
$\dot{q}_{y,out}$
$\dot{q}_{x,out}$
dz
$\dot{q}_{y,in}$
dx
z
y
$\dot{q}_{z,in}$
dy
x
z
y
x



$$\frac{dU}{dt} = \sum_{i=\{x,y,z\}} \boxed{\dot{Q}_{i,in}} - \sum_{i=\{x,y,z\}} \boxed{\dot{Q}_{i,out}} + \sum_{s} \boxed{\dot{Q}_s}$$

$$\dot{Q}_{x,in} = dA_x \cdot \dot{q}_{x,in} = dy \cdot dz \cdot \dot{q}_{x,in}$$

$$\dot{Q}_{y,in} = dA_y \cdot \dot{q}_{y,in} = dx \cdot dz \cdot \dot{q}_{y,in}$$

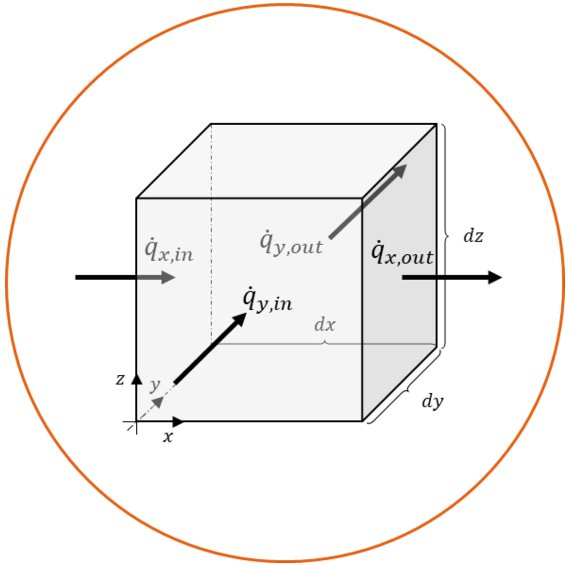
$$\dot{Q}_{z,in} = dA_z \cdot \dot{q}_{z,in} = dx \cdot dy \cdot \dot{q}_{z,in}$$

$$\dot{Q}_{x,out} = dA_x \cdot \dot{q}_{x,out} = dy \cdot dz \cdot \dot{q}_{x,out}$$

$$\dot{Q}_{y,out} = dA_y \cdot \dot{q}_{y,out} = dx \cdot dz \cdot \dot{q}_{y,out}$$

$$\dot{Q}_{z,out} = dA_z \cdot \dot{q}_{z,out} = dx \cdot dy \cdot \dot{q}_{z,out}$$

$$\dot{Q}_s = dV \cdot \dot{q}_s = dx \cdot dy \cdot dz \cdot \dot{q}_s$$



$$\rho dxdydz$$

$$\frac{dU}{dt} = \frac{d(dm\, c_p dT)}{dt} = \sum_{i=\{x,y,z\}} \boxed{d\dot{Q}_{i,in}} - \sum_{i=\{x,y,z\}} \boxed{d\dot{Q}_{i,out}} + \sum_{s} \boxed{d\dot{Q}_s}$$

$$d\dot{Q}_s = dV \cdot \dot{q}_s = dx \cdot dy \cdot dz \cdot \dot{q}_s$$

$$d\dot{Q}_{x,in} = dA_y \cdot \dot{q}_{x,in} = dy \cdot dz \cdot \dot{q}_{x,in}$$
$$d\dot{Q}_{y,in} = dA_x \cdot \dot{q}_{y,in} = dx \cdot dz \cdot \dot{q}_{y,in}$$

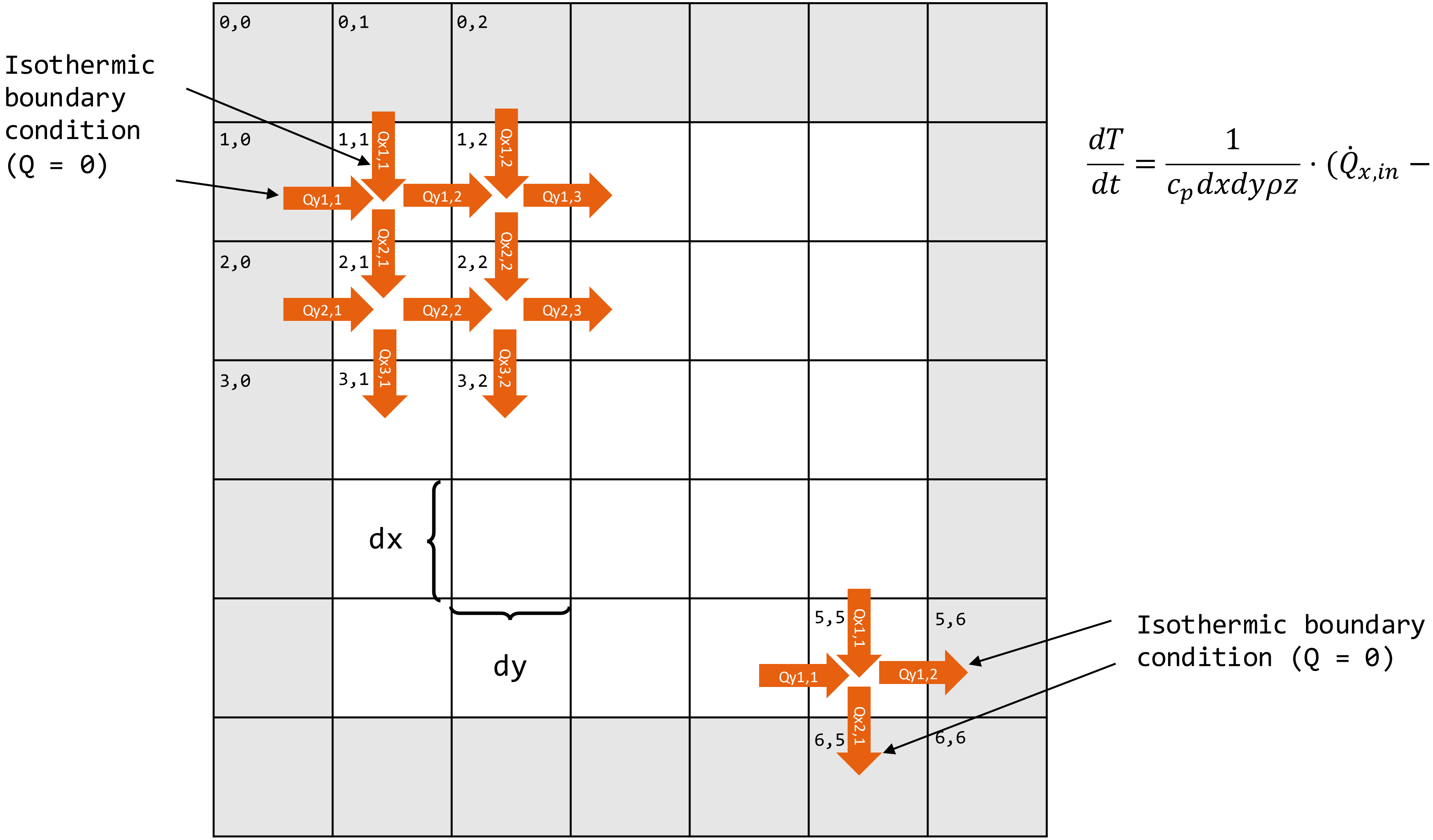
$$d\dot{Q}_{x,out} = dA_y \cdot \dot{q}_{x,out} = dy \cdot dz \cdot \dot{q}_{x,out}$$
$$d\dot{Q}_{y,out} = dA_x \cdot \dot{q}_{y,out} = dx \cdot dz \cdot \dot{q}_{y,out}$$

constants

ρ … $[^{kg}/_{m^3}]$ density
c_p … $[^{J}/_{kgK}]$ spcific heat capacity
λ … $[^{J}/_{kgK}]$ heat conductivity
$\dot{q}_s$ … $[^{W}/_{m^3}]$ power source

$$\dot{q}_{x,in} = -\lambda \cdot {}^{dT}/_{dx} = -\lambda \cdot \frac{T_{x,y} - T_{x-1,y}}{dx}$$
$$\dot{q}_{y,in} = -\lambda \cdot {}^{dT}/_{dy} = -\lambda \cdot \frac{T_{x,y} - T_{x,y-1}}{dy}$$

$$\dot{q}_{x,out} = -\lambda \cdot {}^{dT}/_{dx} = -\lambda \cdot \frac{T_{x+1,y} - T_{x,y}}{dx}$$
$$\dot{q}_{y,out} = -\lambda \cdot {}^{dT}/_{dy} = -\lambda \cdot \frac{T_{x,y+1} - T_{x,y}}{dy}$$



$$\frac{dT}{dt} = \frac{1}{c_p dxdy\rho z} \cdot (\dot{Q}_{x,in} - \dot{Q}_{i,out} + \dot{Q}_{y,in} - \dot{Q}_{y,out} + \dot{Q}_s)$$