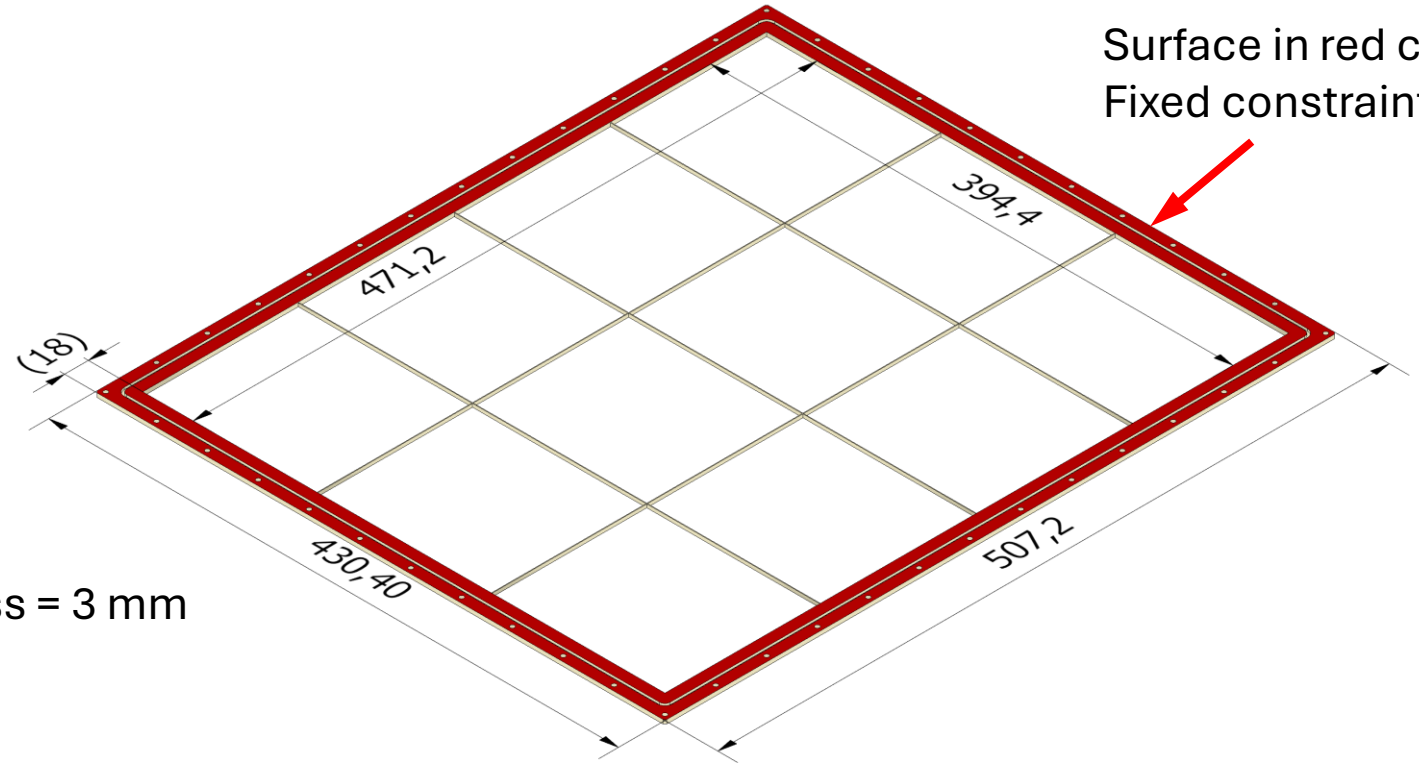
Large Area Spacer Grid Simulation

2025-04-18 - ePIC MPGD ECT Meeting

Stefano Gramigna – sgramigna@roma2.infn.it

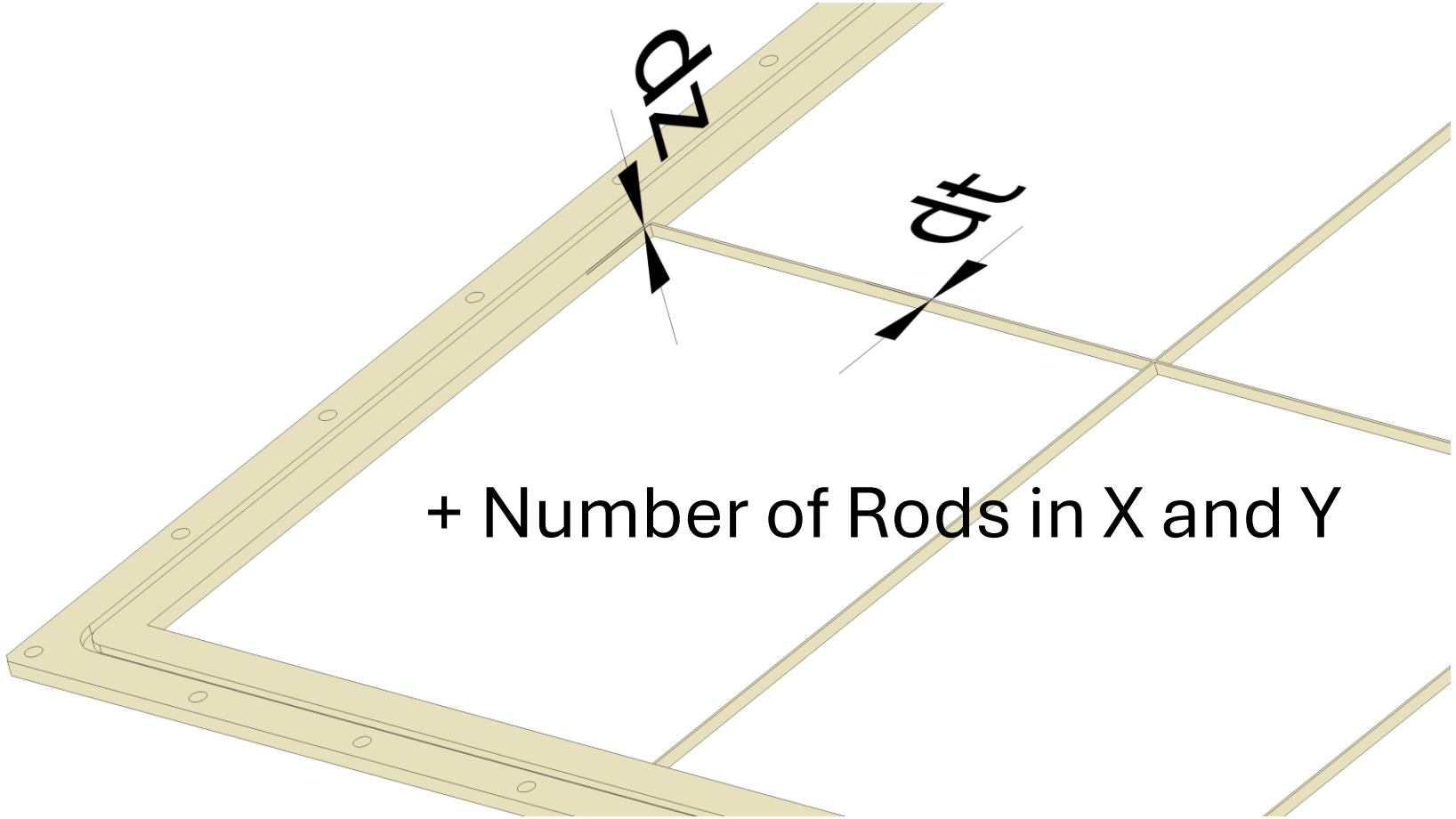
CLAS12 LA Prototype Spacer Grid Geometry



Thickness = 3 mm

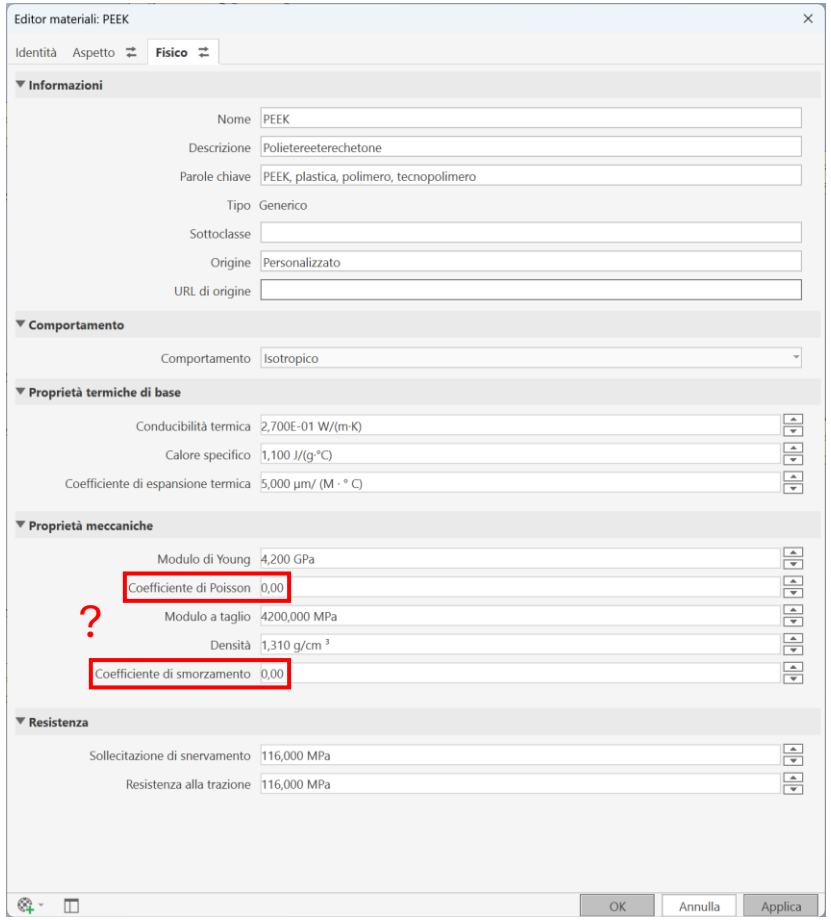
According to Rui the spacer grid should never touch the µ-RWELL PCB

Geometrical Parameters



Stefano Gramigna - sgramigna@roma2.infn.it

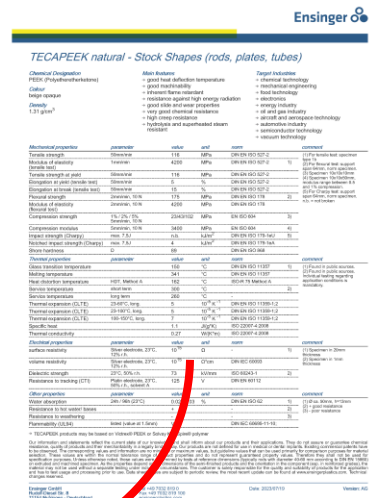
Material Parameters: PEEK Definition



Density
1.31 g/cm^3

- good slide and wear properties
- very good chemical resistance
- high creep resistance
- hydrolysis and superheated steam resistant

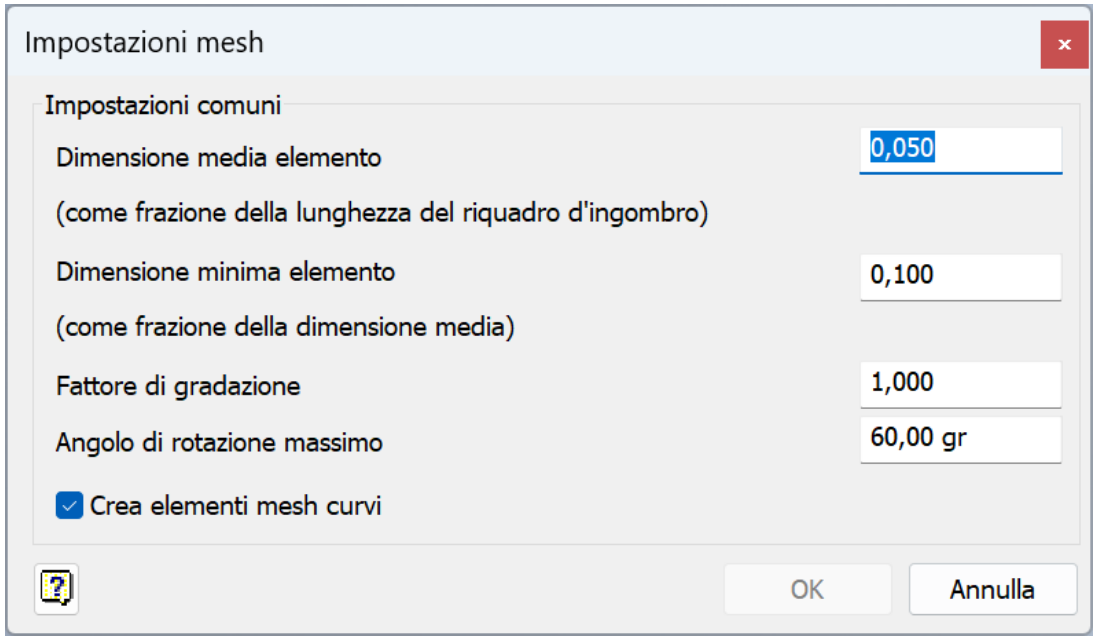
Mechanical properties	*parameter*	*value*	*unit*
Tensile strength	50mm/min	116	MPa
Modulus of elasticity (tensile test)	1mm/min	4200	MPa
Tensile strength at yield	50mm/min	116	MPa
Elongation at yield (tensile test)	50mm/min	5	%
Elongation at break (tensile test)	50mm/min	15	%
Flexural strength	2mm/min, 10 N	175	MPa
Modulus of elasticity (flexural test)	2mm/min, 10 N	4200	MPa
Compression strength	1% / 2% / 5% 5mm/min, 10 N	23/43/102	MPa
Compression modulus	5mm/min, 10 N	3400	MPa
Impact strength (Charpy)	max. 7,5J	n.b.	kJ/m^2
Notched impact strength (Charpy)	max. 7,5J	4	kJ/m^2
Shore hardness	D	89	
Thermal properties	*parameter*	*value*	*unit*
Glass transition temperature		150	°C
Melting temperature		341	°C
Heat distortion temperature	HDT, Method A	162	°C
Service temperature	short term	300	°C
Service temperature	long term	260	°C
Thermal expansion (CLTE)	23-60°C, long.	5	10^{-5} K^{-1}
Thermal expansion (CLTE)	23-100°C, long.	5	10^{-5} K^{-1}
Thermal expansion (CLTE)	100-150°C, long.	7	10^{-5} K^{-1}
Specific heat		1.1	J/(g*K)
Thermal conductivity		0.27	W/(K*m)

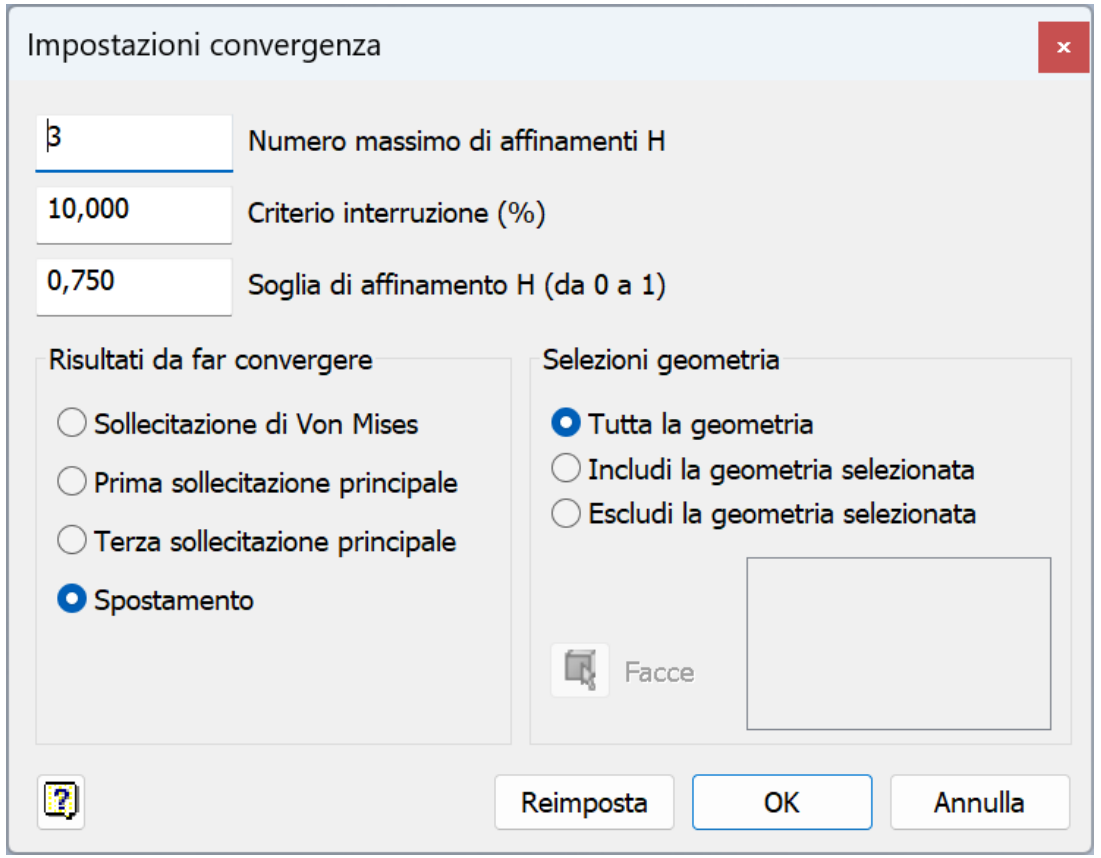


Ensinger TECAPEEK Natural Datasheet

Other simulation parameters

The only force applied to
the object is the force of gravity

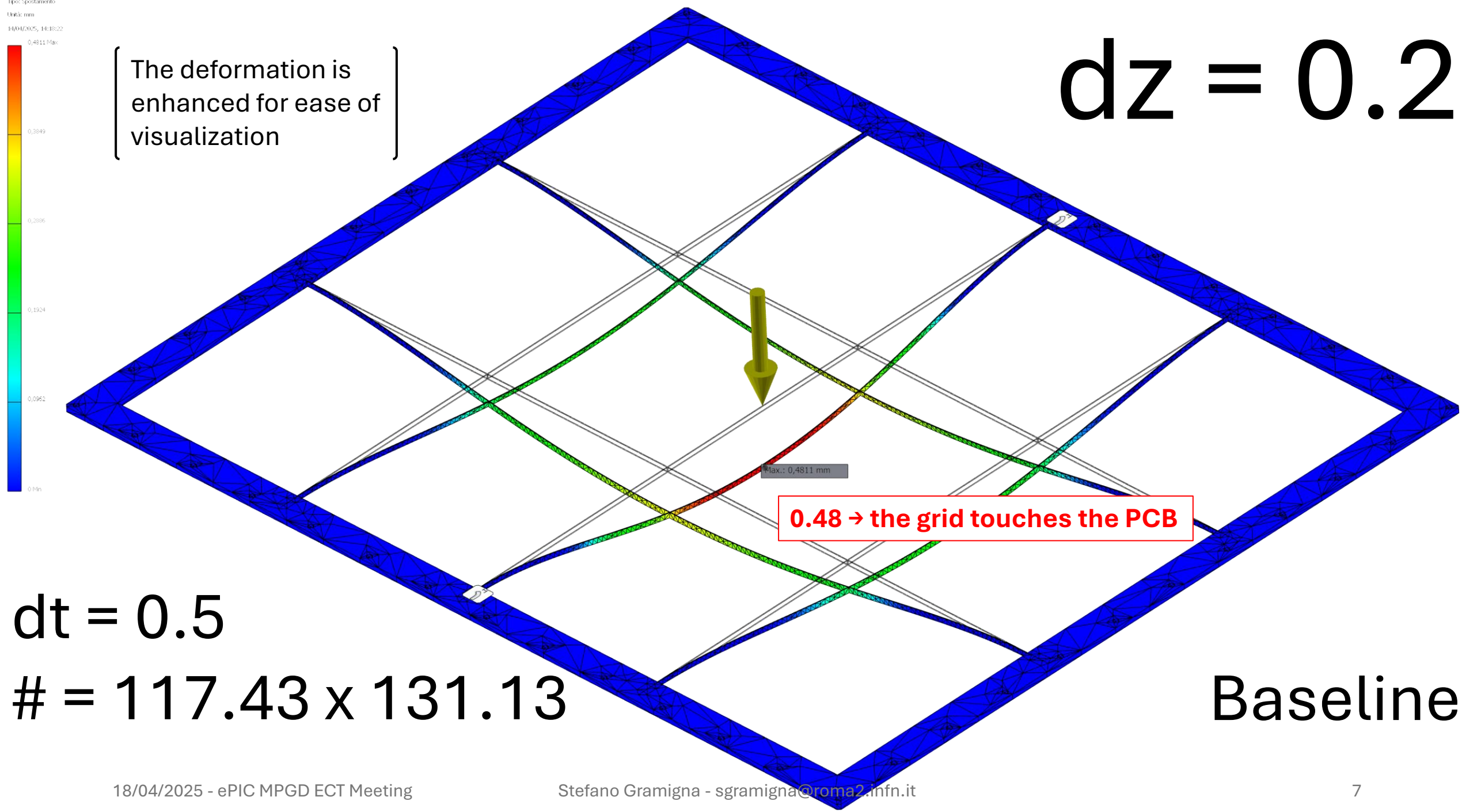




Simulation Results

dz = 0.2

The deformation is enhanced for ease of visualization



dt = 0.5

= 117.43 x 131.13

Baseline

Summary of Tested Configurations

Variant	dz	dt	Rods in X	Rods in Y	Mesh size	Max deformation
Baseline	0.2	0.5	3	2	117.43 x 131.13	0.48
Baseline	0.5	0.5	3	2	117.43 x 131.13	0.60
Baseline	1.0	0.5	3	2	117.43 x 131.13	0.93
Thick rods	0.5	1.0	4	3	117.05 x 130.80	0.57
Thin rods	0.5	0.3	4	3	117.58 x 131.25	0.61
Fine mesh	0.2	0.5	4	3	93.84 x 98.20	0.49
Fine mesh	0.5	0.5	4	3	93.84 x 98.20	0.61
Fine mesh	1.0	0.5	4	3	93.84 x 98.20	0.95
Slab	0.2	NA	NA	NA	NA	0.25

The grid either touches the PCB or it is ineffective in containing GEM displacement

Proposed Solutions

1. Small reliefs on the botom face of the spacer grid to contact the PCB in matching dead regions

PROS

- Easiest implementation
- No additional tooling required
- Limited requirement for studies/simulations

CONS

- Largest loss of active area and efficiency

2. No spacer grid, high mechanical tension applied to the GEM

PROS

- No active area loss
- No additional tooling required

CONS

- Risky
- Long term stability uncertain
- GEM Holes may be deformed
- Might require a modification of the GEM stretcher clamps
- Requires studies/simulations (of an anisotropic and inhomogeneous material…)

3. Tensioned spacer grid

PROS

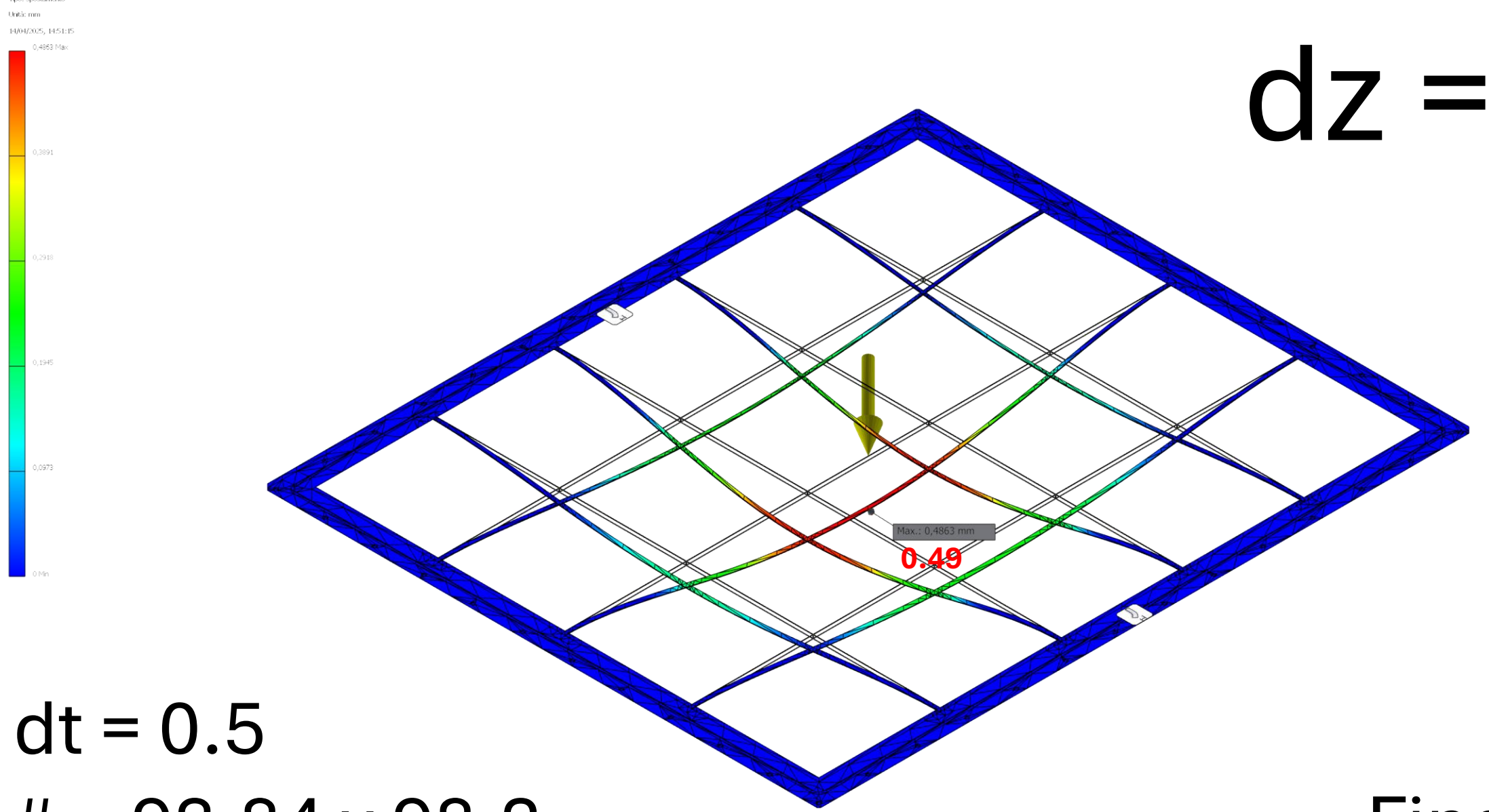
- Moderate efficiency loss

CONS

- Long term stability uncertain
- Requires dedicated assembly gig
- Might increase frame bulk
- Requires studies/simulation (of a homogeneous material)

Backup

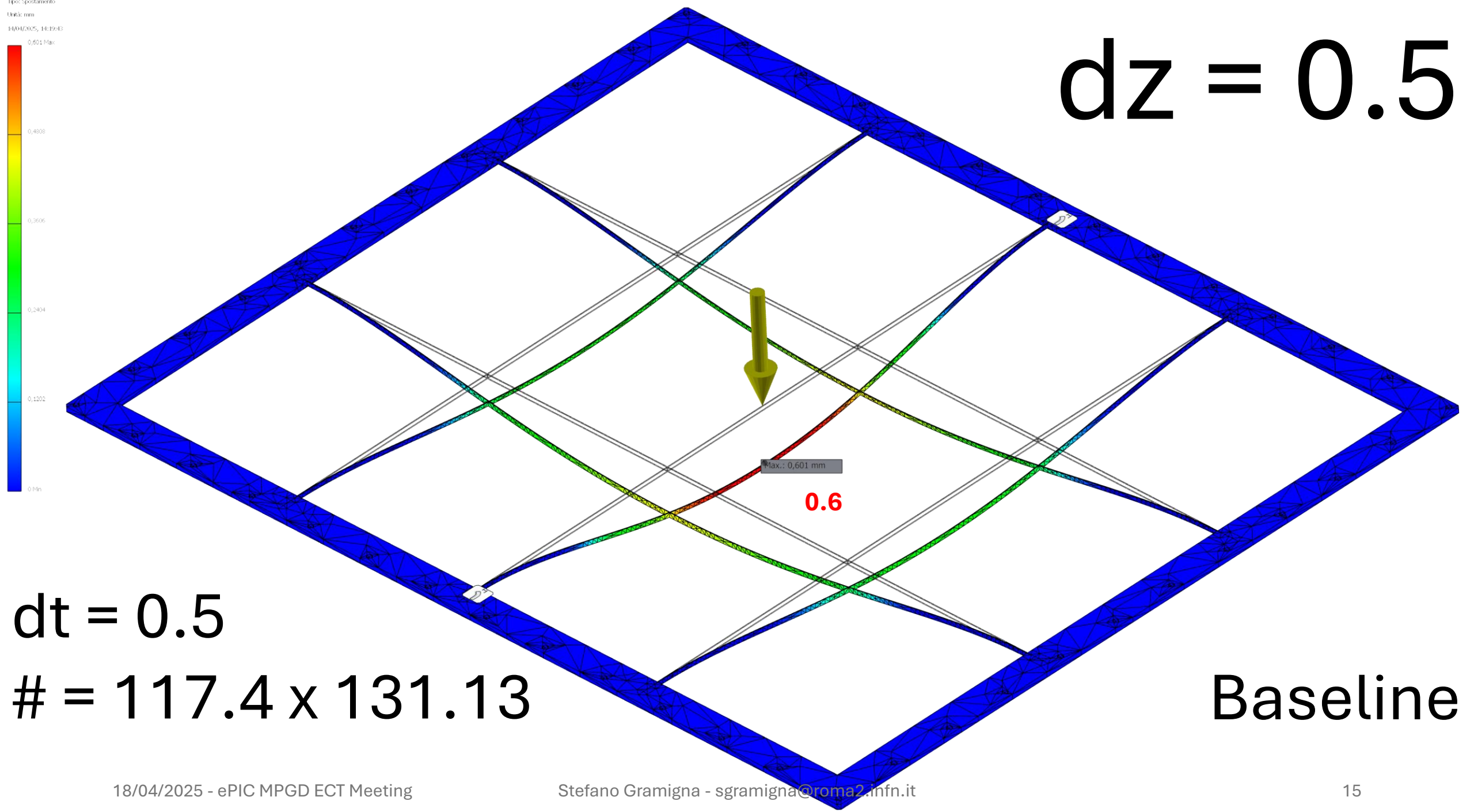
dz = 0.2



dt = 0.5

= 93.84 x 98.2

Fine mesh



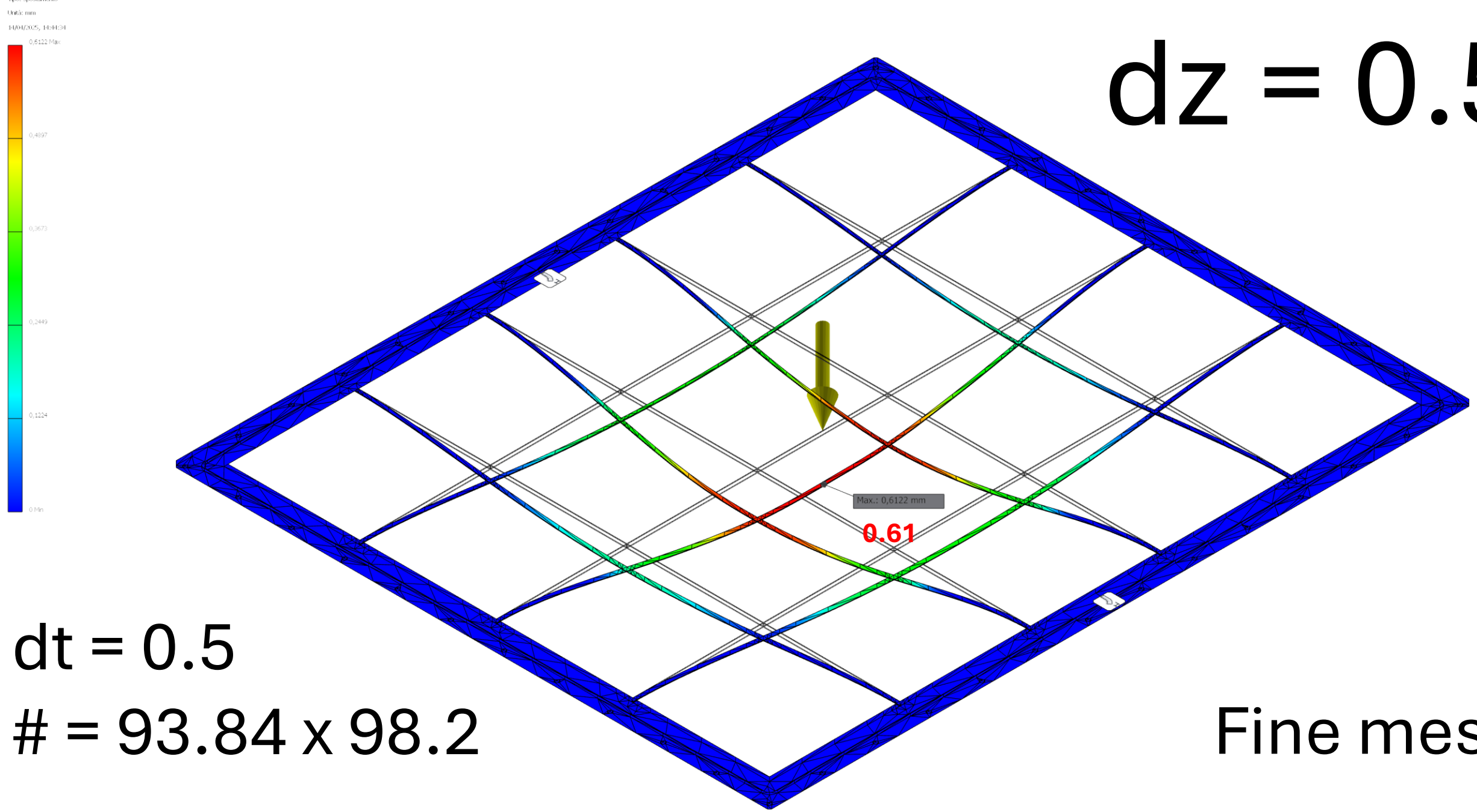
dz = 0.5

dt = 0.5

= 117.4 x 131.13

Baseline

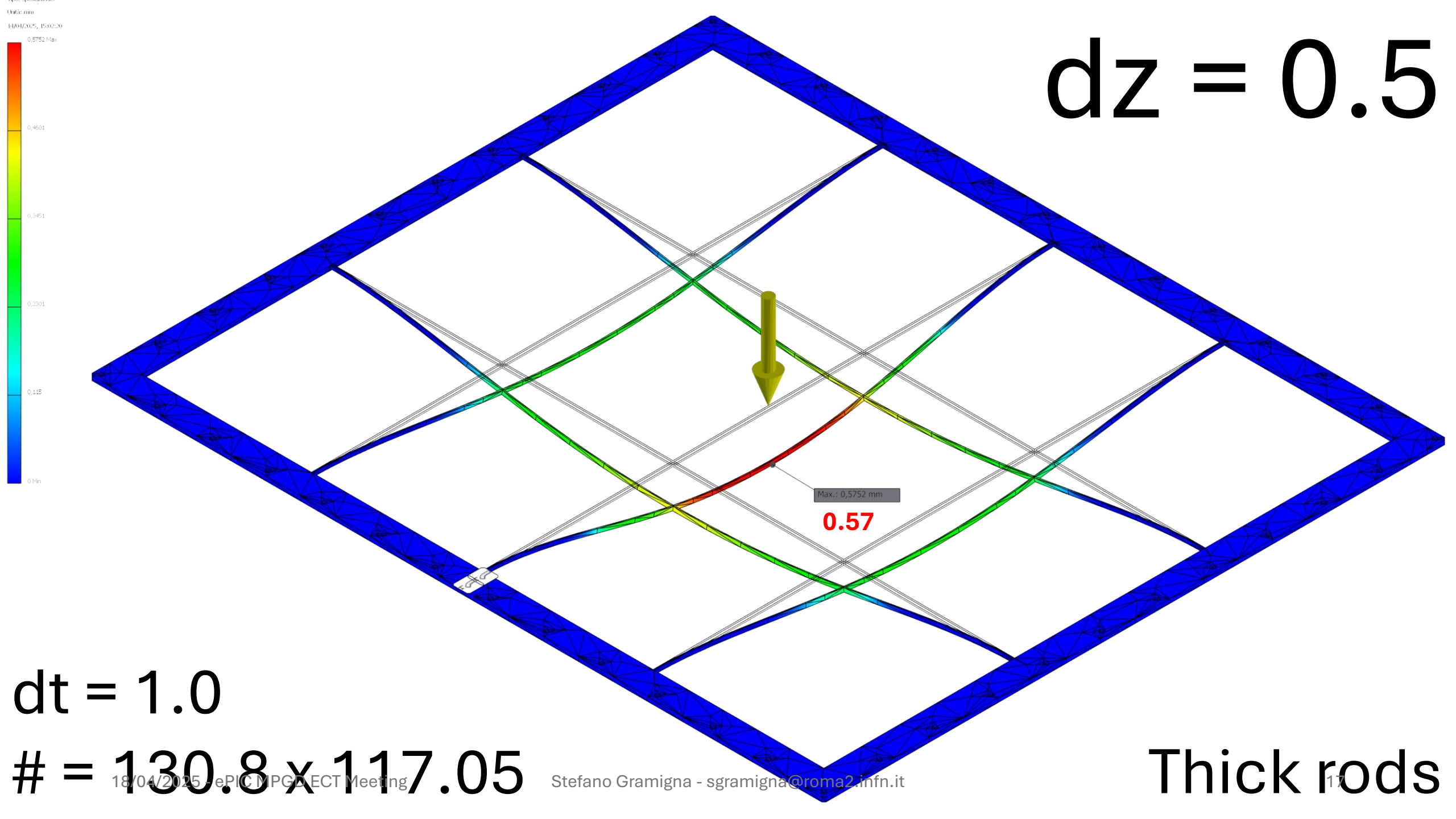
dz = 0.5

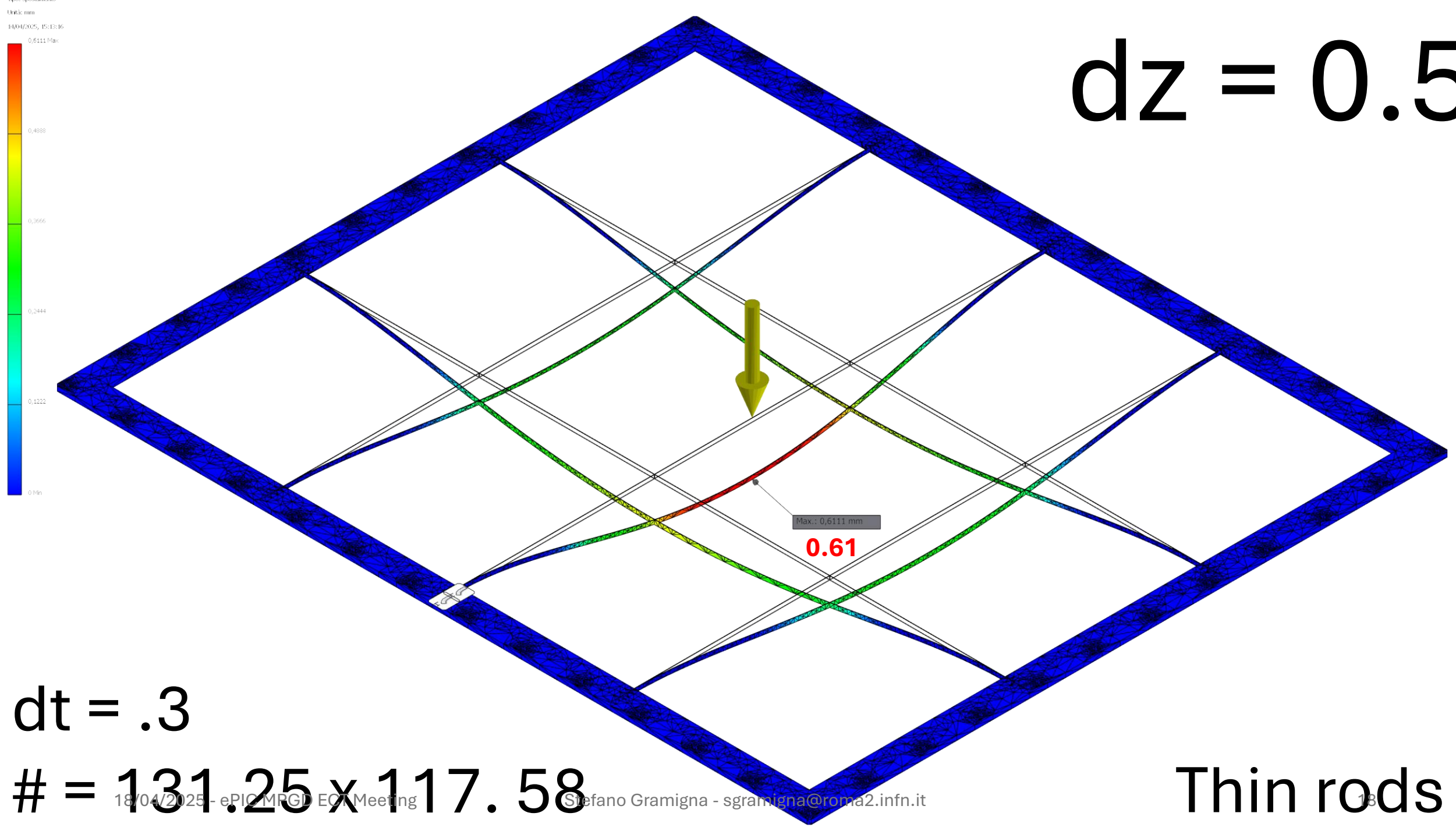


dt = 0.5

= 93.84 x 98.2

Fine mesh


dz = 0.5
Max.: 0,5752 mm
0.57
dt = 1.0
# = 130.8 x 117.05
Thick rods

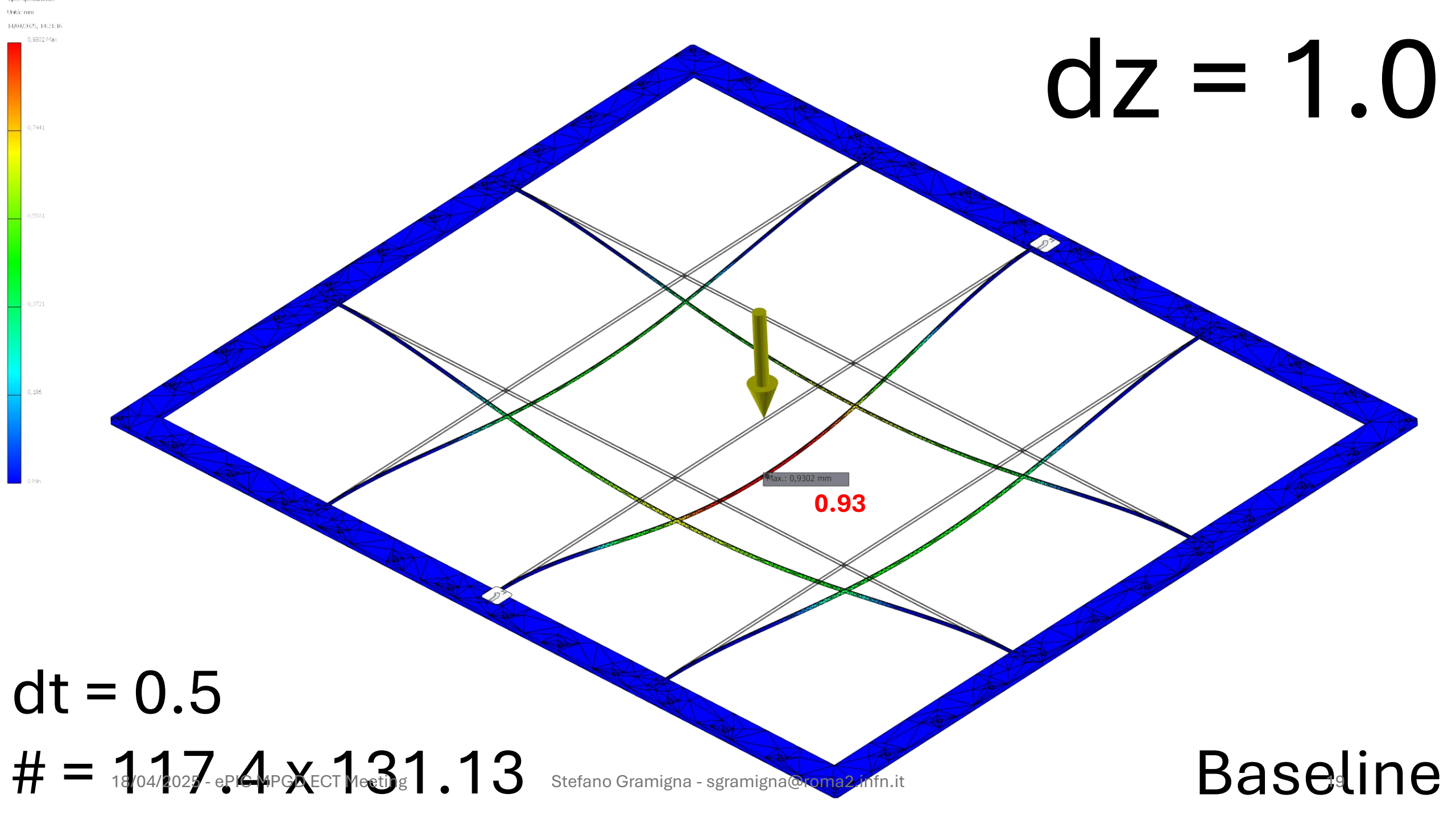


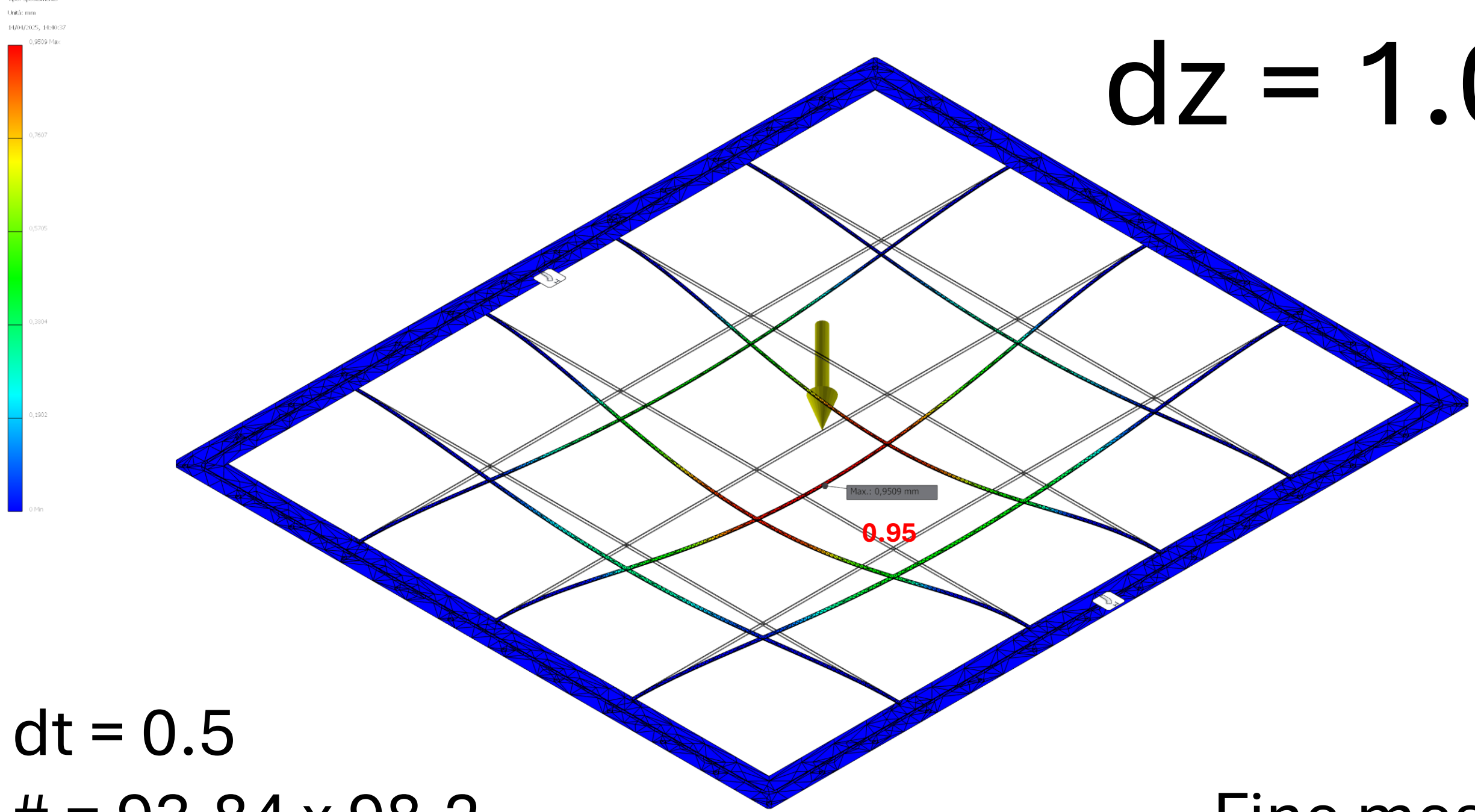
dz = 0.5

dt = .3

= 131.25 x 117. 58

Thin rods


dz = 1.0
0,9302 Max
0,7441
0,5581
0,3721
0,186
0 Min
Max.: 0,9302 mm
0.93
dt = 0.5
# = 117.4 x 131.13
Baseline

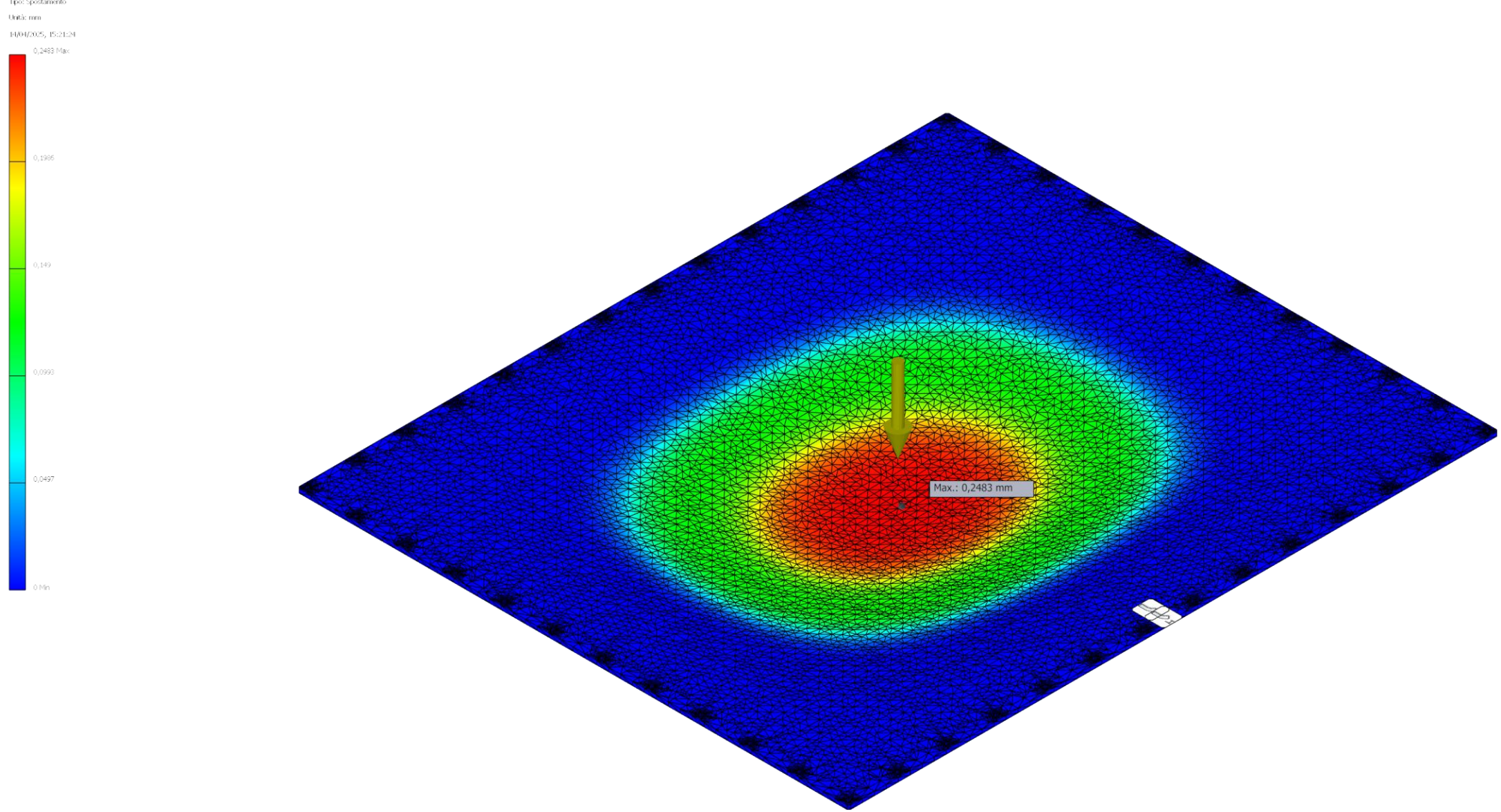


dz = 1.0

dt = 0.5

= 93.84 x 98.2

Fine mesh


Tipo: Spostamento
Unità: mm
14/04/2025, 15:21:24
0,2483 Max
0,1986
0,149
0,0993
0,0497
0 Min
Max.: 0,2483 mm