

ONE-NODE QUADRATURE FOR EXPLICIT ISOGEOMETRIC ANALYSIS IN STRUCTURAL DYNAMICS

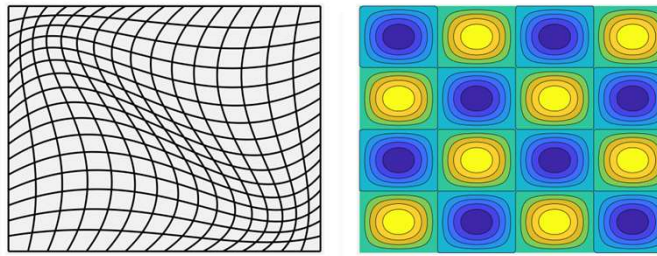
NEW QUADRATURE METHOD REDUCES COMPUTATIONAL COST OF ISOGEOMETRIC EXPLICIT DYNAMICS CODES

STATUS QUO

Explicit structural dynamics codes, used extensively in car crash analysis, metal forming and blast, require optimized solution updates to achieve highly efficient transient calculations. All ingredients are present in contemporary linear finite element codes based on mass lumping, reduced quadrature, and hourglass stabilization. A competitive higher order spatially accurate technology – with the promise to deliver more accurate and efficient numerical simulation – has so far not been realized.

OUR TECHNOLOGY

Explicit dynamics calculations are characterized by complex non-linear material behavior encoded in costly constitutive routines that are evaluated at each quadrature point at each time step. The invention involves an innovative quadrature technique that for the first time achieves the minimum number of global evaluations while maintaining higher order accuracy. The computational cost of evaluating the constitutive equations is therefore comparable to the linear finite element method.



BENEFITS

- Cost of evaluation of constitutive routines is reduced by at least a factor of 10.
- Higher order accurate computations are maintained enabling computation on coarser meshes leading to a reduction in computational cost by at least a factor of 10.
- Resulting compute kernels are perfectly structured for GPU's, leading to another speedup by at least a factor of 10.

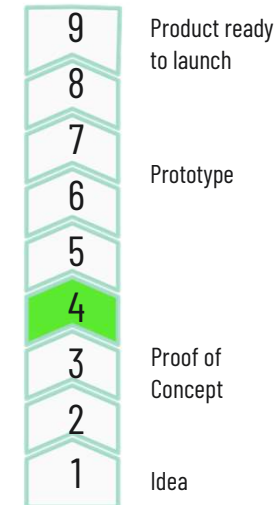
APPLICATION POSSIBILITIES

Explicit structural dynamics simulation used for application in car crash analysis, metal forming, and blast.

COMMERCIALIZATION OPPORTUNITIES

There are various possibilities for cooperation between the industrial partner and TU Darmstadt: from an exchange with the know-how carriers of the technology up to a close cooperation in case of further development needs. The technology is protected by intellectual property rights and can be used by the industry partner after a sale or licensing agreement.

CURRENT STAGE OF DEVELOPMENT TECHNOLOGY READINESS LEVEL (TRL)



The technology development is at Level 4: We carried out extensive testing and code optimization at the level of relevant benchmarks in structural dynamics, including nonlinear dynamics of shell structures.

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