Computational Strategies for Solving Dynamic Contact Problems

HU-MATHS-IN
Hungarian Service Network for Mathematics in Industry and Innovations

The Industrial Problem

Engineering structures often contain parts which are in contact. Solving contact problems is one of the most challenging tasks in numerical analysis of structures. The appearing numerical oscillation during the solution makes the results uncertain.

Research group

Numerical Mechanics Research Group

The main interest of the research group is focused on solving dynamic contact problem using finite element method.

Company

Audi Hungária Department of

Audi Hungaria G/GF-21

The use dynamic FEM-Simulations before real testing to predict the fatigue lifetime of car body or engine components and to predict noise, vibration and harshness behavior of the car.

SZÉCHENYI 2020
MAGYARORSZÁG KORMÁNYA
Európai Unió
Európai Strukturális és Beruházási Alapok
BEFEKTETÉS A JÖVŐBE

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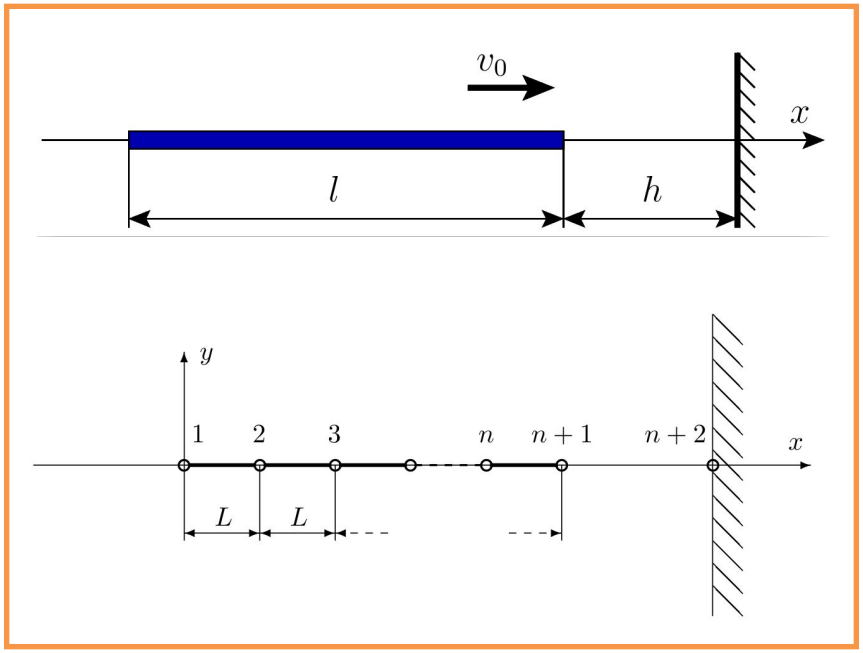
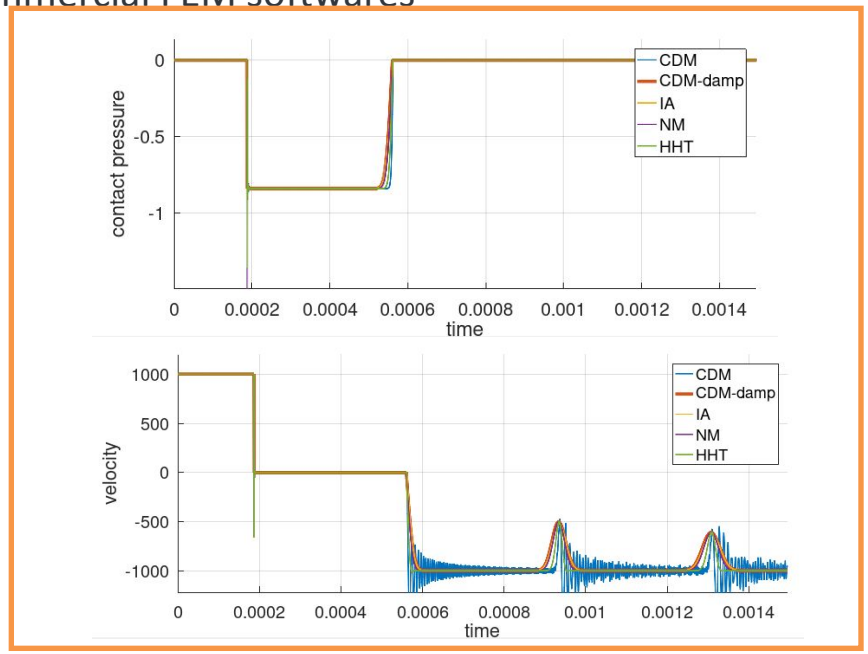
Challenges & Goals

- Contact-impact problems cause big difficulties in industrial applications
- There are a number of methods that are not effective enough
- The industry needs a faster and more accurate method
- This method should be easily implemented into commercial FEM softwares





Oscillations during a contact-impact problem (red line presents the proposed method)

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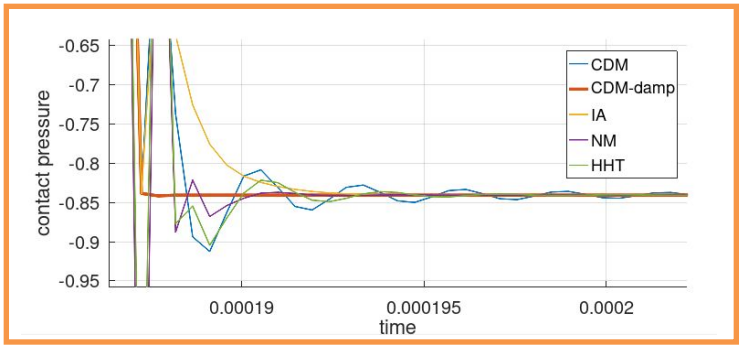
Mathematical and computational methods and techniques applied

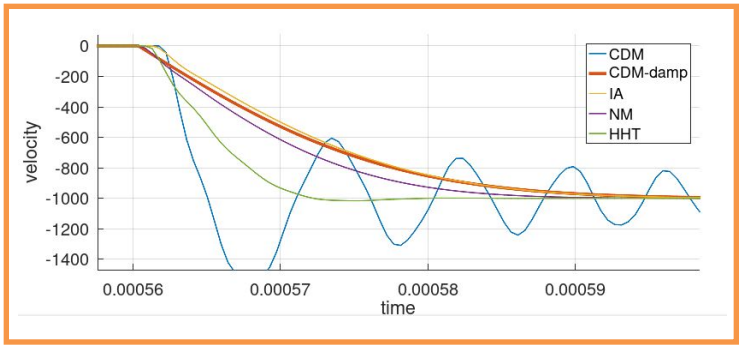
- Solution of the contact problem is equivalent to the semi-discretised problem

$$M\ddot{u}+C\dot{u}+Ku+G^T p=f \qquad G(u+X)=0$$

- Usually the numerical dissipation of the applied time stepping method reduces the oscillations in the results.
- In our method a properly chosen damping matrix eliminates all the oscillations
- Applying the explicit central difference method with this damping matrix the oscillation are totally eliminated while less computational time is needed.



Oscillations of the contact pressure during a contact-impact problem (red line presents the proposed method)



Oscillations of the velocity during a contact-impact problem (red line presents the proposed method)

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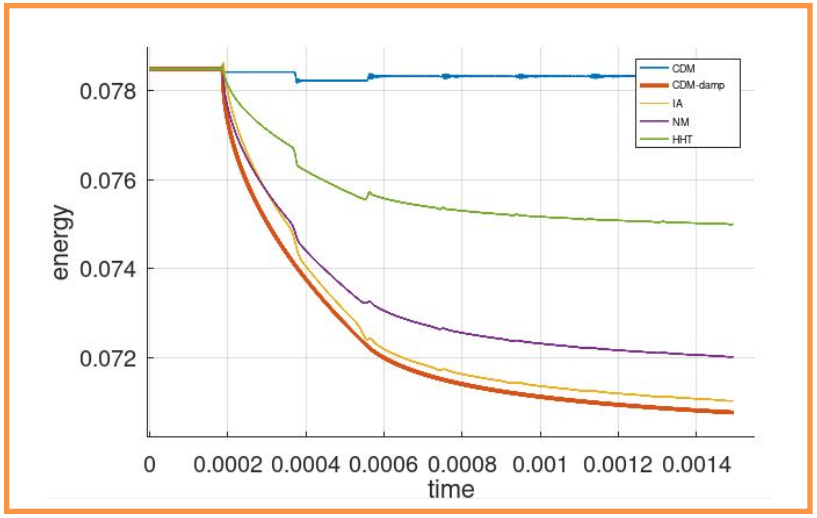
Results & Benefits to the company

- Results
  - Oscillation during solution of contact problems can be avoided
  - The proposed method faster and more accurate than the currently used ones

- Benefits
  - The proposed method can be easily implemented into commercial FEM softwares
  - The proposed methods reduces cost and time of the development



Energy dissipation of the studied methods