Examples

Handling an increasing number of contacts

Flexible and stable solvers

Painlevé paradox

Analytical results reproducible

Outlook

Application of multigrid methods
Exploit time coherence
Eliminate friction cone approximation
Incorporation of joints and springs

Problem Formulation

Simulation cycle

Collision Detection

Time Integration

Collision Response

Body properties

Contact points

Contact forces

Friction cone defines set of possible contact forces

Final Linear Complementarity Problem (LCP)

\[
\begin{pmatrix}
N^T J^T \dot{\beta} + \Delta t & \geq 0 \\
\mu \dot{f}_n - E_{\eta}^T \beta & \geq 0 \\
E_{\eta} \lambda + D^T J^T \dot{\beta} + \Delta t & \geq 0
\end{pmatrix}
\begin{pmatrix}
\Delta t \beta \\
\Delta t f_n \\
\Delta t \lambda
\end{pmatrix}
\geq \begin{pmatrix}
0 \\
0 \\
0
\end{pmatrix}
\]

Legend

- \( \vec{n} \): Contact normal
- \((\vec{t}_n, \vec{t}_\eta)\): Tangential plane
- \(\mu\): Coefficient of friction
- \(\eta\): Friction cone facets
- \(J\): Jacobian matrix
- \(M\): Mass matrix
- \(f_n\): Normal components
- \(\beta\): Friction components

Legend

- LCP-Solvers
  - Direct Solvers
  - Lemke Algorithm
  - Iterative Solvers
  - Damped Newton Methods
  - Matrix-Splitting Methods
  - Interior Point Methods