The Software NEWEUL

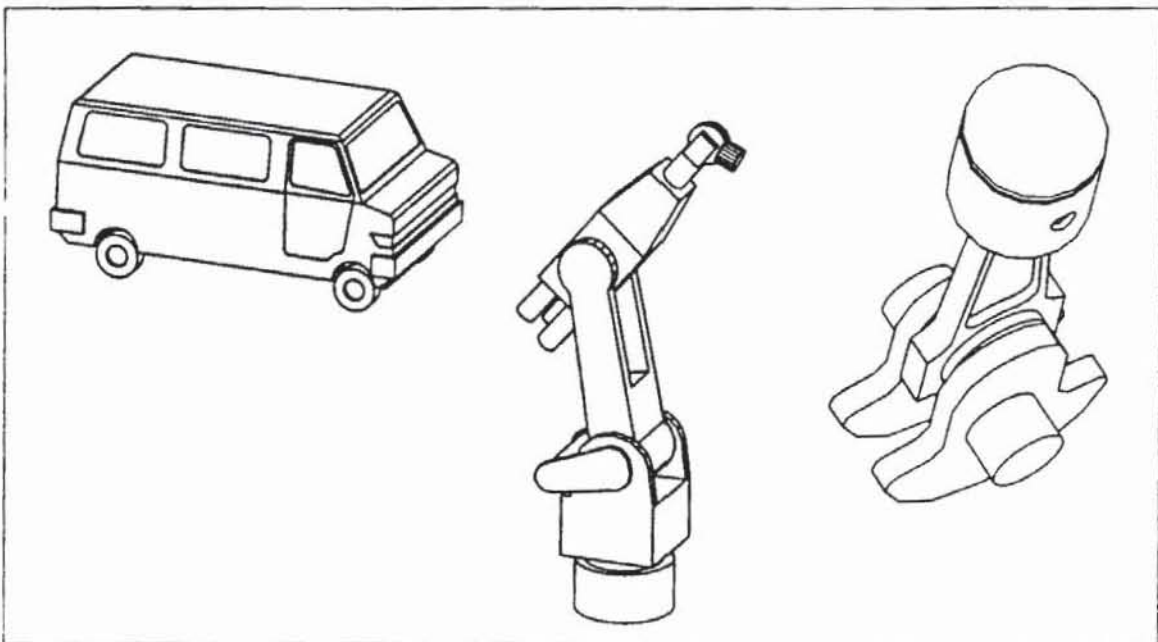## by G. Leister, E. Kreuzer and W. Schiehlen

_____ What is NEWEUL ? _____

NEWEUL is a software package for the dynamic analysis of mechanical systems with the multibody system method. It comprises the computation of the symbolic equations of motion and the simulation of the dynamic behavior.

_____ Fields of Application _____

The software package NEWEUL has been successfully applied in industrial and academic research institutions since 1979. The major fields of application are

- O   vehicle dynamics,
- O   robot dynamics,
- O   satellite dynamics,
- O   dynamics of machinery,
- O   biomechanics,
- O   dynamics of mechanisms.
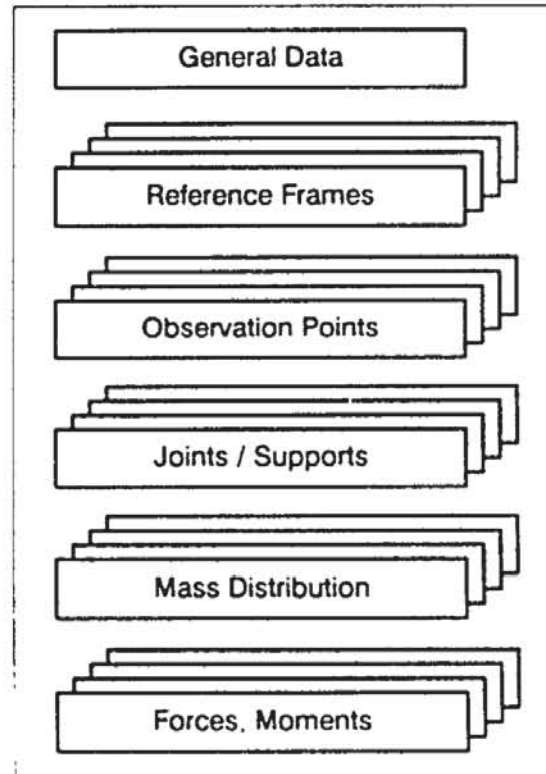
NEWEUL application examples

_____ NEWEUL Input _____

The software package NEWEUL offers two approaches for multibody system modeling. These are

○   the successive assembly approach using the kinematics of relative motions, and
○   the modular assembly approach based on subsystems.

The input data for NEWEUL have to be entered in input files prepared with prompts and comments. The user has to provide only simple expressions for the description of kinematics and mass distribution with respect to arbitrary reference frames.

Observation points allow the determination of position, velocity and acceleration of arbitrary points of the multibody system.

| General Data |
| Reference Frames |
| Observation Points |
| Joints / Supports |
| Mass Distribution |
| Forces, Moments |

Structure of a NEWEUL input file

_____ Equations of Motion _____

NEWEUL generates the equation of motion of multibody systems in symbolic form. The computation is based on a Newton–Euler formalism with application of the principles of d'Alembert and Jourdain. The resulting equations of motion can be

○   linear,
○   partially linearized, or
○   nonlinear

symbolic differential equations. Constant parameters can be included in numerical form. Nonlinear coupling elements in kinematically linear models are also permitted.

For the output format of the equations of motion several options are possible. FORTRAN compatible output allows the equations to be included in commercial software packages for dynamic analysis and simulation such as, for instance, ACSL. Another output format allows the processing of the equations with the symbol manipulation program MAPLE.

Control parameters for compression and factorization enable the user to change the structure of the output equations. For example, the user may want to obtain fully symbolic equations of motion in order to check the results for modeling and input errors. Later, computationally efficient compressed equations can be generated for the verified model.

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Fully symbolic output:                          Factorized output:

C>    Inertia Matrix                    C>    Inertia Matrix
      M(1,1)=M1*A**2+I1+                       M(1,1)=(C*C*(M2+M3)+
      +       M2*C**2+M3*C**2                  +         (M1*A**2+I1))

      M(2,1)=-M2*B*C*SIN(AL1)*COS(AL2)+        M(2,1)=C*B*M2*SIN(AL2-AL1)
      +       M2*B*C*SIN(AL2)*COS(AL1)         M(2,2)=(M2*B**2+I2)
      M(2,2)=M2*B**2+I2
                                               M(3,1)=C*B*M3*SIN(AL1-AL3)
      M(3,1)=M3*B*C*SIN(AL1)*COS(AL3)-         M(3,2)=0.
      -       M3*B*C*SIN(AL3)*COS(AL1)         M(3,3)=(M3*B**2+I3)
      M(3,2)=0.
      M(3,3)=M3*B**2+I3
```

Fully symbolic and factorized output of an inertia matrix

_____ Simulation _____

The software module NEWSIM allows the simulation of the symbolic equations of motion provided by NEWEUL. NEWEUL automatically generates a problem specific simulation program. The user simply has to add the specification of

- O   force laws,
- O   system parameter values, and
- O   initial conditions.

The simulation results are stored in ASCII data files that can be visualized with arbitrary graphics packages.

The simulation results may contain

- O   the time history of the state variables,
- O   the kinematical data of observation points,
- O   data for animation,
- O   the time history of the reaction forces, and
- O   user-defined output data.

_____ Hardware Requirements _____

The software package NEWEUL is written in FORTRAN77 and can be implemented on any workstation or mainframe with a FORTRAN77 compiler. NEWEUL uses its own symbol manipulator.

_____Scope of Delivery_____

The software package NEWEUL is delivered in source code along with user's manuals. Also, a collection of test examples of various fields of application is provided which makes it easy to get started and demonstrates many of the features of NEWEUL.

_____ Contact Persons _____

If you like to obtain more information about the software package NEWEUL, to make an appointment for a demonstration with an example of your field of interest, or to receive an official offer, please contact

> Prof. Dr.-Ing. W. Schiehlen,
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For further information you may also call

> Prof. Dr.-Ing. E. Kreuzer, phone (040) 7718-3120, or
> Dipl.-Ing. P Schäfer, phone (0711) 685-6391.

_____ References _____

Schiehlen, W.; Kreuzer, E.: Rechnergestütztes Aufstellen der Bewegungsgleichungen gewöhnlicher Mehrkörpersysteme. Ing-Arch.46 (1977) pp 185-195.

Schiehlen, W. (ed.): Multibody Systems Handbook. Berlin/...: Springer-Verlag, 1990.

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