

MEMO	EV/M18.006
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Subject	Release-notes for CONTACT version 18.1

Summary

These release-notes document the changes in CONTACT version 18.1 with respect to version 17.1.

- Many options are added to the free version, including the Extended CONTACT model [1], and fast calculations with FFTs [2, 3].
- The automated processing of wheel and rail profiles has been improved and is provided now in the CONTACT library also (Figure 1).

Note that features of the **commercial versions** are **marked in blue** in these release notes and the further documentation.

1 Options added to the free version

Whereas the basic version of CONTACT has been provided freely by VORtech since 2009, many extensions were provided on a commercial basis:

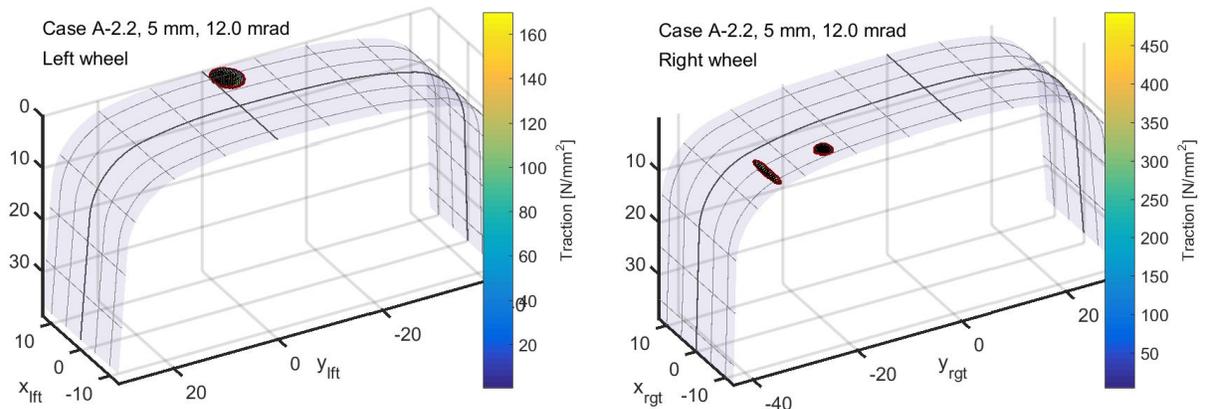


Figure 1: *Results of the new w/r contact module for the Manchester benchmark example: steering to the right with 12.0 mrad yaw and 5 mm lateral displacement.*

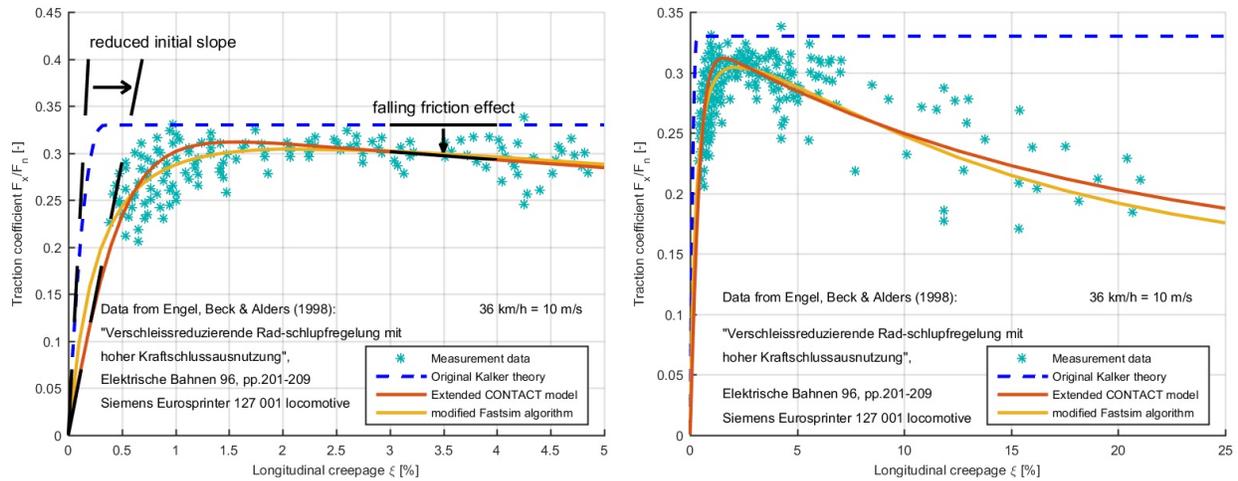


Figure 2: Measured and computed creep forces for the Siemens locomotive Eurosprinter 127001 for pure longitudinal creepage, including results for the Modified FASTSIM approach.

- The Extended CONTACT model, incorporating the effects of interfacial layers and falling friction at large creepage [1], see Figure 2,
- Fast solvers NormCG and TangCG, on the basis of the FFT algorithm [2, 3],
- Options IBASE = 9 and E = 9, with full control over undeformed distance and rigid slip,
- Extended output to the mat-file and the full subsurface stress tensor ($A = 2$),
- The use of visco-elastic materials ($M = 1$).

These options are now open to all, included in the free version. The basic CONTACT module 3 is made free for all applications, whereas [module 1 for wheel/rail contact](#) and the [CONTACT library](#) for Matlab, Fortran and C are provided on a commercial basis.

2 Automated processing of wheel/rail profiles

In version 17.1, we introduced the analysis of contact geometry for wheel/rail situations as a beta version. This functionality has been improved and evaluated and is now ready for operational use.

This wheel/rail contact functionality is implemented as a separate “module 1” as illustrated in Figure 3. It relieves the user of one tough problem, the calculation of the undeformed distance function. Whereas previous CONTACT versions focused on the contact problem itself, requiring that this undeformed distance be specified precisely, the new version focuses on the contact problem as a whole, including the contact geometry analysis.

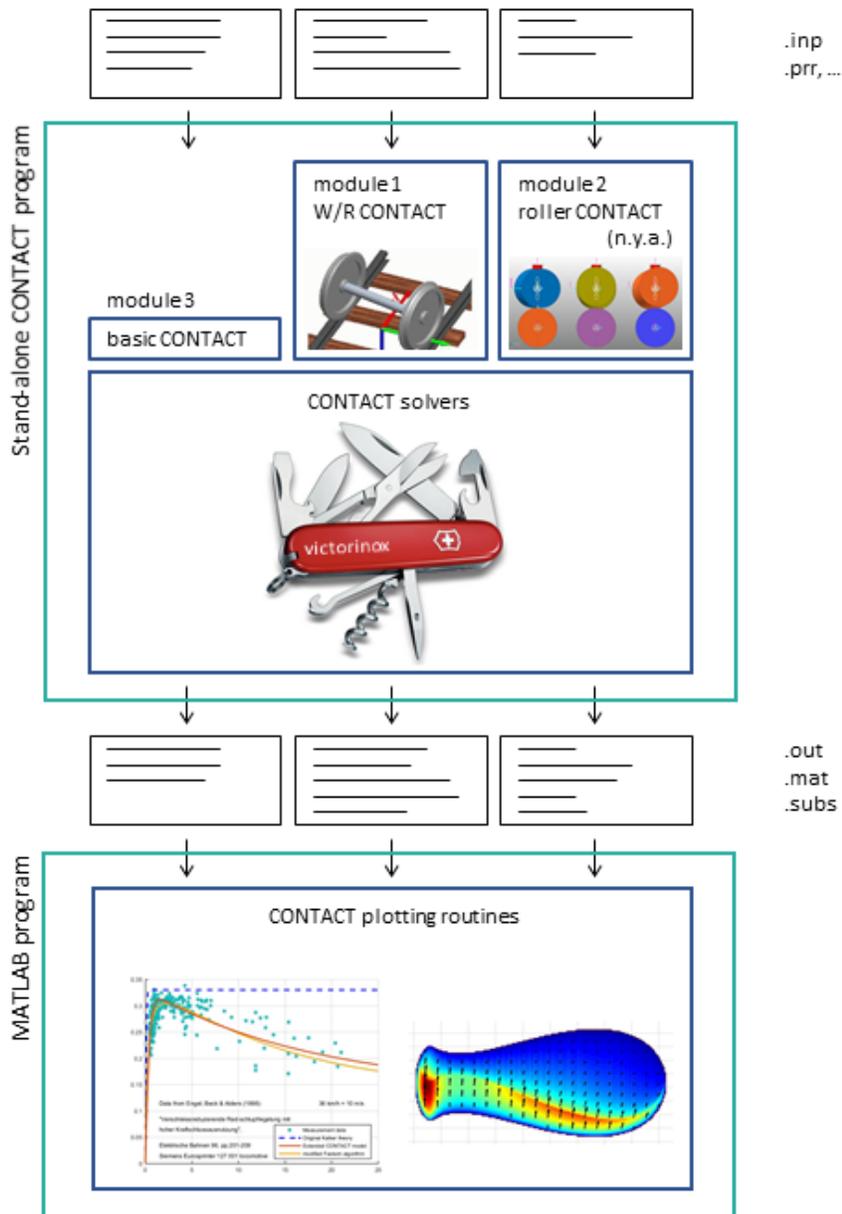


Figure 3: Structure of a calculation using the stand-alone CONTACT program.

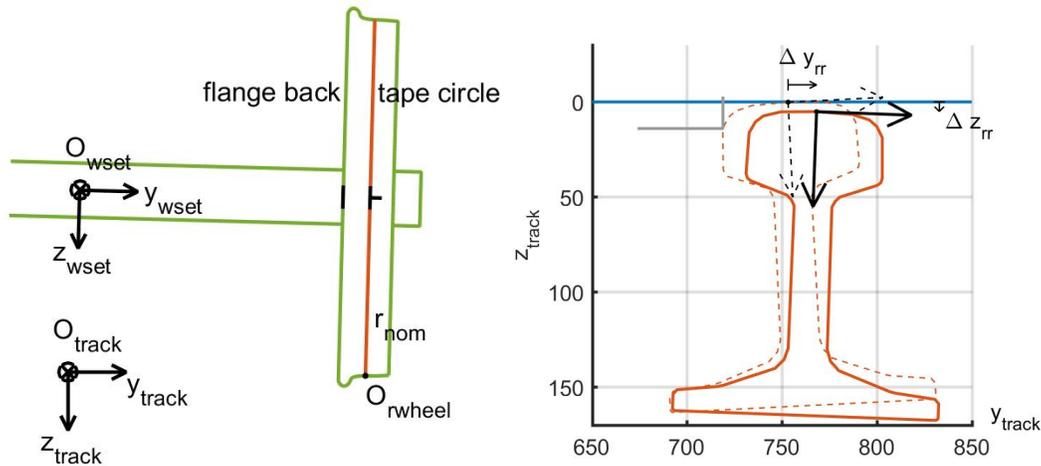


Figure 4: *Wheel/rail contact is implemented generically, locating the wheel and rail profiles in space using the wheelset position and track deviations, including the effects of yaw and roll.*

The contact geometry problem is approached generically, including yaw and supporting multiple contact patches. Not all the desired functionality has been implemented yet, like smoothing or profiles with multiple sections, as needed for switches and crossings. The functionality that's provided will grow over time.

3 Guided input and restart options removed

In previous versions, a guided input facility was provided that explained and asked the inputs to CONTACT in a step-by-step way. This guided input facility has been removed from the program, which is now fully file-based as shown in Figure 3. The reason is that the guided input was a maintenance burden, and could not be extended easily with the functionality of module 1. Furthermore, the creation of input-files has been facilitated by providing examples and further specification.

Along with the GI, we also removed the option to continue an earlier run and the option to compute subsurface stresses separately from the main calculation. These options did not add much flexibility and weren't used very often. By this change, input modes 0, 1, 4, 5, 6 and 7 have all been removed. This simplifies the work-flow for using CONTACT as shown in Figure 3, and allowed to eliminate the bac- and p-files also.

4 Resolved problems

- Several improvements were made in module 1 for w/r contact analysis.
- The support for Miniprof ban- and whl-files is extended, introducing automatic reordering, mirroring and removal of points where profiles fold back and become multi-valued.

5 Compatibility w.r.t. previous versions

The multi-grid option is discontinued.

- Input-files using module 5 can be changed to use module 3 instead.

In module 1 for w/r contact, the specification of wheel and rail profiles is changed. The corresponding changes to the user's input files are as follows:

- The control digit C_1 should be added to indicate whether the left (0) or right (1) wheel is to be considered;
- The flags `RGHRAI` and `RGTWHE` should be removed, whereas `MIRRORY` should be added;
- The position y_{tc} of the tape circle line (`TAPCRC`) is replaced by the position y_{fbpos} of the flange back in wheel coordinates (`FBPOS`), changing the sign from $+70$ to -70 mm.

In the `CONTACT` library, new named constants have been added to the include-file.

- The interface of `cntc_setrailprofile` and `cntc_setwheelprofile` is changed with respect to version v17.1.1.
- The order and number of outputs is changed in `cntc_getcontactlocation` and `cntc_getglobalforces`.

The output-values provided are changed for module 1. The new outputs can be read into MATLAB using the script `parse_out1.m`.

The `mat`-file is changed with respect to the meta-data, concerning the contact reference location.

6 Known problems and restrictions

The Windows uninstaller does not support multiple versions (v17.1, v18.1) side by side. If you want to uninstall a previous version then do it first, before installing a newer version. If an installation is broken, consult the "Installation" section in the file `README.txt` for manual installation tips.

One feature that is not treated well is the rolling direction parameter `CHI`. It is generally advised to use $CHI = 0$ or 180° or restrict `CHI` to at most a few degrees.

The results may contain a significant discretisation error when a small number of elements (7×7 , 15×15) is used. Particularly the frictional work appears to be susceptible to this.

Premium version & CONTACT library

The basic version of CONTACT is freely available in binary form, and can be downloaded from www.kalkersoftware.org. “Module 1” for wheel/rail contact geometry processing is provided commercially through a [premium version](#) and through the [CONTACT library for MATLAB, Fortran and C](#). This functionality is marked [blue](#) in the release notes and in the User Guide. For information on licenses you may contact us at support@kalkersoftware.org.

References

- [1] E.A.H. Vollebregt. Numerical modeling of measured railway creep versus creep-force curves with CONTACT. *Wear*, 314:87–95, 2014.
- [2] E.A.H. Vollebregt. A new solver for the elastic normal contact problem using conjugate gradients, deflation, and an FFT-based preconditioner. *J. of Computational Physics*, 257, Part A:333–351, 2014.
- [3] J. Zhao, E.A.H. Vollebregt, and C.W. Oosterlee. A fast nonlinear conjugate gradient based method for 3D concentrated frictional contact problems. *J. of Computational Physics*, 288:86–100, 2015.