

Vecto 3.x Release Notes

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1 Vecto 3.0.1 Release Notes

1.1 General Notes

Vecto 3.0 has been rewritten from scratch. It is now a dynamic program library that contains the core simulation and can be embedded in other applications.

Vecto 3.0.1 has been integrated in the graphical user interface of Vecto 2.2 via an additional “Start” button on the main screen (cf. Figure 1). Additionally, a command-line program is provided to run multiple Vecto jobs (cf. Figure 2). For more information how to use the command-line program please see “vectocmd.exe - h”.

In case you find a bug or Vecto 3.0 does not behave as expected **please follow the instructions** given in Section 2.

1.2 Changes in Vecto 3.0.1

- New distance-based simulation model
- Simulation with variable steps. The simulation distance is adapted such that the respective time is about 0.5s (parameter `TARGETTIMEINTERVAL`). Certain simulation events are calculated using adapted time intervals (e.g. for traction interruption or to exactly meet the target speed vs. distance cycle).
- Accuracy of simulated distance vs. driving cycle distance $< 1 \mu\text{m}$

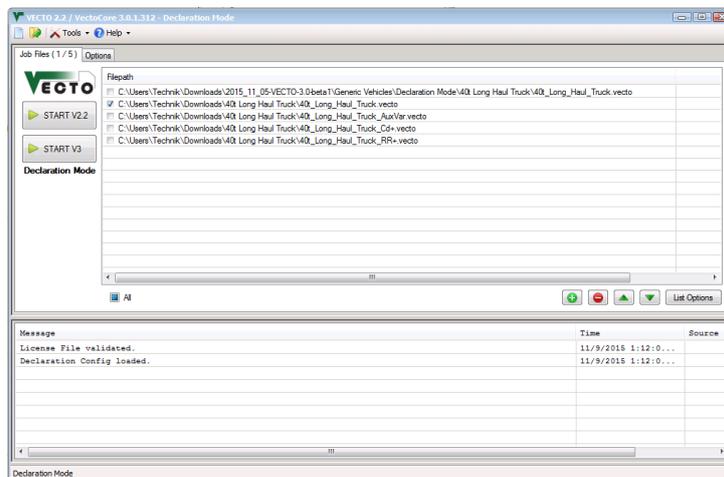


Figure 1: Vecto 3.0.1 Graphical User Interface

```

C:\Windows\system32\cmd.exe
C:\Workspaces\VisualStudio\VECTO_quan\VectoConsole\bin\Debug>vectocmd.exe -h
VectoConsole: 3.0.1.312
VectoCore: 3.0.1.312

Commandline Interface for Vecto.

Synopsis:
vecto.exe [-h] [-v] FILE1.vecto [FILE2.vecto ...]

Description:
FILE1.vecto [FILE2.vecto ...]: A list of vecto-job files (with the
extension: .vecto). At least one file must be given. Delimited by
whitespace.

-t: output information about execution times
-mod: write mod_data in addition to sum_data
-eng: switch to engineering mode (implies -mod)
-v: Shows verbose information (errors and warnings will be displayed)
-vv: Shows more verbose information (infos will be displayed)
-vvv: Shows debug messages (slow!)
-uvv: Shows all verbose information (everything, slow!)
-u: Show version information
-h: Displays this help.

Examples:
vecto.exe "12t_Delivery_Truck.vecto" 40t_Long_Haul_Truck.vecto
vecto.exe 24tCoach.vecto 40t_Long_Haul_Truck.vecto
vecto.exe -v 24tCoach.vecto
vecto.exe -v jobs:40t_Long_Haul_Truck.vecto
vecto.exe -h

```

Figure 2: Vecto 3.0.1 Command Line Program

- New component-based software architecture
 - Separate software component for every part of the power-train: Combustion Engine, Clutch, Gearbox, Retarder, Axle Gear Vehicle, Wheels, Driver, Driving Cycle
 - The models of every component are taken from Vecto 2.2
 - Interfaces for components reflecting physical quantities: force/velocity, angular speed/torque, ...
 - Power-train components modularly usable, custom power-train configurations possible
- DRIVERSTRATEGY as separate component with well-defined interface
- GEARSHIFTSTRATEGY as separate component with well-defined interface
- All computations are done in SI units; data-types reflect concrete SI units (i.e., kg, m, s, Nm, ...)
- Run-time conformity check of SI units on all computations and SI conversions. (might be relaxed for final release version)
- Traction interruption of arbitrary time possible (also < 1 s), accurate simulation of traction interruption time
- New IDLE-CONTROLLER to simulate engine speed during traction interruption periods
- Intelligent search of operating point during coasting, braking, and in engine-overload situations, deviation from FLD < 0.5 W (parameter ENGINEPOWERSEARCHTOLERANCE).
- Exact analytic solutions instead of exhaustive search where possible, e.g., computing engine's preferred speed, computing time interval required for driving a certain distance, compute distance required to decelerate to a given target speed depending on the driver's deceleration curve, computation of distance to drive when accelerating before braking, ...
- Support sparse representation of driving cycles. Instead of specifying the driving cycle on a per-meter basis only distance entries with speed or slope changes need to be specified. Reduction of 96 % in disk space
- Multi-threaded execution when multiple driving cycles resp. multiple Vecto jobs are executed
- Vecto 3.0.1 only supports the latest version of the input file formats (JSON), i.e., .vecto: v 2; .vveh: v 7; .vgbx: v 5; .veng: v 3

| Technik_FITIPC 2015-11-09 16_29_02.coverage | 2277 | 11,86% | 16929 | 88,14% |
|---|------|--------|-------|---------|
| vectocore.dll | 1684 | 15,31% | 9318 | 84,69% |
| TU.Graz.VectoCore.FileIO.EngineeringFile | 4 | 40,00% | 6 | 60,00% |
| TU.Graz.VectoCore.Models.SimulationComponent.Data.Engine | 170 | 35,42% | 310 | 64,58% |
| TU.Graz.VectoCore.Models.SimulationComponent.Data.Gearbox | 74 | 34,26% | 142 | 65,74% |
| TU.Graz.VectoCore.Models.SimulationComponent.Data | 292 | 30,39% | 669 | 69,61% |
| TU.Graz.VectoCore.FileIO | 12 | 24,00% | 38 | 76,00% |
| TU.Graz.VectoCore.Exceptions | 10 | 20,83% | 38 | 79,17% |
| TU.Graz.VectoCore.UHls | 168 | 17,07% | 816 | 82,93% |
| TU.Graz.VectoCore.FileIO.Reader.Impl | 68 | 15,81% | 362 | 84,19% |
| TU.Graz.VectoCore.Models.Simulation.Impl | 96 | 15,12% | 539 | 84,88% |
| TU.Graz.VectoCore.Models.SimulationComponent.Impl | 542 | 14,82% | 3116 | 85,18% |
| TU.Graz.VectoCore.Models.Simulation.Data | 96 | 12,47% | 674 | 87,53% |
| TU.Graz.VectoCore.FileIO.Reader | 50 | 11,79% | 374 | 88,21% |
| TU.Graz.VectoCore.FileIO.Reader.DataObjectAdaper | 44 | 9,78% | 406 | 90,22% |
| TU.Graz.VectoCore.Models.Declaration | 58 | 3,17% | 1769 | 96,83% |
| Global Classes | 0 | 0,00% | 10 | 100,00% |
| TU.Graz.VectoCore.Configuration | 0 | 0,00% | 13 | 100,00% |
| TU.Graz.VectoCore.FileIO.DeclarationFile | 0 | 0,00% | 5 | 100,00% |
| TU.Graz.VectoCore.Models | 0 | 0,00% | 10 | 100,00% |
| TU.Graz.VectoCore.Models.Connector.Ports.Impl | 0 | 0,00% | 14 | 100,00% |
| TU.Graz.VectoCore.Models.SimulationComponent | 0 | 0,00% | 7 | 100,00% |

Figure 3: Screenshot of Test-coverage Report (Microsoft Visual Studio)

- Support for arbitrary order of columns in CSV files if the header is given as specified in the Manual. If the header is not recognized: fall-back to column-based parsing
- more energy-efficient implementation of *Overspeed*: vehicle acceleration only due to road's slope, engine is on drag-curve
- Use of well-known logging framework (NLog) allows to configure logging output based on severity and namespace. Supports different logging targets
- Implemented in C#, requires .Net Framework version 4.5
- Use of latest libraries for logging, parsing JSON files, and processing of PDF files
- 270 unit- and integration-tests developed; 262 tests passed by Vecto release; 4 tests failed due to unreasonable vehicle configuration (torque outside loss-map range), 4 tests failed due to unreasonable driving cycles (15 % and 25 % uphill)
 - Code coverage: 84 %
The main parts of the code are covered by tests, parts with low coverage are mainly auto-generated equality methods and parsing of input data (cf. Figure 3)
- Code complexity¹: currently the max. complexity is 20 (single method) and 10 methods have a complexity >10. The most complex methods are in the ShiftStrategy, the DriverStrategy, and the Powertrain builder; see Figure 4.

1.3 Open Issues

- Sanity checks on input data
- Refactoring of DefaultDriverStrategy to handle certain situations when braking is required during coasting to meet small target-speed changes during coasting.
- Status output to GUI/Console during simulation
- Advanced Driver Assist Systems
- Adaptation of component models to most recent ACEA Whitebook

¹According to *SourceMonitor*

| Checkpoint Name | Created On | Files | Lines | Statements | Comments | % Docs | Classes | Methods/Class | Calls/Method | Stmts/Method | Max Complexity | Max Depth | Avg Depth | Avg Complexity |
|-----------------|-------------|-------|--------|------------|----------|--------|---------|---------------|--------------|--------------|----------------|-----------|-----------|----------------|
| Checkpoint2 | 24 Sep 2015 | 149 | 15,613 | 6,506 | 2,2 | 14.9 | 298 | 3,58 | 2,49 | 3,06 | 16 | 7 | 1.79 | 1.62 |
| Checkpoint1 | 23 Jul 2015 | 130 | 11,647 | 5,318 | 2,7 | 11.8 | 255 | 3,45 | 2,20 | 2,61 | 11 | 6 | 1.73 | 1.44 |
| Baseline | 27 Jun 2015 | 119 | 9,378 | 4,150 | 3,2 | 12.9 | 215 | 3,17 | 2,23 | 2,95 | 11 | 6 | 1.89 | 1.44 |

| File Name | Lines | Statements | % Comments | % Docs | Classes | Methods/Class | Calls/Method | Stmts/Method | Max Comple | Max Depth | Avg Depth | Avg Complexity |
|---|-------|------------|------------|--------|---------|---------------|--------------|--------------|------------|-----------|-----------|----------------|
| ModelSimulationComponentImplShiftStrategy.cs | 23 | 192 | 4.9 | 11.1 | 1 | 4.9 | 6.9 | 4.4 | 3 | 6 | 2.5 | 19.28 |
| ModelSimulationComponentImplPowertrainBuilder.cs | 104 | 114 | 2.2 | 1.6 | 1 | 11.00 | 4.91 | 8.18 | 16 | 6 | 2.58 | 2.82 |
| ModelSimulationComponentImplGearbox.cs | 276 | 147 | 0.3 | 15.4 | 1 | 15.00 | 2.94 | 6.44 | 15 | 4 | 2.03 | 2.65 |
| ModelSimulationDataModelHead.cs | 323 | 41 | 0.8 | 0.3 | 4 | 3.00 | 3.07 | 2.64 | 13 | 6 | 2.09 | 1.85 |
| ModelSimulationComponentImplDistanceBasedDrivingCycle.cs | 433 | 188 | 3.0 | 2.3 | 3 | 10.67 | 2.06 | 3.88 | 13 | 7 | 2.23 | 2.15 |
| ModelSimulationDataSummaryFileWriter.cs | 267 | 217 | 2.2 | 0.5 | 3 | 4.67 | 10.00 | 9.28 | 12 | 4 | 1.77 | 2.71 |
| ModelSimulationComponentImplDriver.cs | 640 | 334 | 5.6 | 12.3 | 3 | 9.00 | 8.22 | 3.99 | 12 | 6 | 2.19 | 2.79 |
| ModelSimulationComponentImplVehicleContainer.cs | 280 | 150 | 0.0 | 0.0 | 1 | 28.00 | 0.71 | 2.75 | 10 | 4 | 1.88 | 1.59 |
| ModelSimulationComponentImplCombustionEngineData.cs | 87 | 53 | 0.0 | 0.0 | 1 | 12.00 | 1.52 | 1.50 | 10 | 3 | 1.87 | 1.97 |
| UnitSIS.cs | 1886 | 668 | 0.2 | 37.5 | 22 | 6.05 | 2.09 | 2.40 | 10 | 5 | 1.71 | 1.56 |
| FileDReaderDataObjectAdapterDeclarationDataAdapter.cs | 286 | 125 | 0.4 | 1.9 | 1 | 11.00 | 5.62 | 3.09 | 8 | 5 | 2.26 | 3.09 |
| FileDReaderDrivingCycleDataReader.cs | 436 | 161 | 1.4 | 10.1 | 6 | 2.67 | 8.88 | 6.94 | 8 | 6 | 2.56 | 3.63 |
| ModelSimulationImplVectorRun.cs | 65 | 82 | 1.0 | 1.9 | 1 | 12.00 | 1.58 | 3.59 | 8 | 6 | 2.26 | 1.41 |
| UnitVectorFile.cs | 177 | 76 | 1.1 | 19.2 | 1 | 7.00 | 9.43 | 7.71 | 8 | 5 | 1.97 | 3.14 |
| FileDReaderObjectAdapterEngineeringDataAdapter.cs | 200 | 87 | 1.0 | 1.5 | 1 | 9.00 | 5.00 | 7.33 | 7 | 4 | 1.92 | 2.33 |
| ModelDeclarationSegments.cs | 124 | 62 | 0.8 | 0.0 | 1 | 6.00 | 10.17 | 7.83 | 7 | 4 | 2.32 | 3.14 |
| ModelSimulationDataModelCarWriter.cs | 156 | 80 | 0.0 | 0.0 | 1 | 18.00 | 1.61 | 2.00 | 7 | 4 | 1.95 | 1.32 |
| ModelSimulationComponentImplFullLoadCurve.cs | 53 | 31 | 0.0 | 0.0 | 1 | 2.00 | 0.50 | 12.00 | 7 | 4 | 2.71 | 7.00 |
| ModelSimulationComponentImplCombustionEngine.cs | 245 | 115 | 2.0 | 6.2 | 3 | 5.67 | 3.76 | 4.06 | 7 | 4 | 2.08 | 2.10 |
| UnitDataTableEngineMethods.cs | 569 | 291 | 1.6 | 3.8 | 3 | 14.67 | 2.70 | 4.09 | 7 | 5 | 2.34 | 1.84 |
| ModelDeclarationPT1.cs | 62 | 36 | 0.0 | 0.0 | 1 | 5.00 | 4.00 | 4.00 | 6 | 4 | 1.81 | 2.80 |
| ModelSimulationComponentImplEnginePT1Curve.cs | 49 | 25 | 0.0 | 0.0 | 1 | 3.00 | 5.33 | 4.33 | 6 | 4 | 1.48 | 2.67 |
| ModelSimulationComponentImplBrakes.cs | 97 | 39 | 0.0 | 11.3 | 2 | 2.50 | 5.00 | 4.40 | 6 | 4 | 1.67 | 2.80 |
| ModelSimulationComponentImplEngineOnlyCombustionEngine.cs | 71 | 38 | 0.0 | 0.0 | 1 | 9.00 | 0.78 | 2.00 | 6 | 4 | 1.50 | 1.50 |
| UnitEnumableEnumerationMethods.cs | 61 | 38 | 0.0 | 6.2 | 1 | 4.00 | 3.00 | 4.25 | 6 | 4 | 1.79 | 2.50 |
| FileDReaderImplDeclarationModeSimulationDataReader.cs | 107 | 53 | 0.0 | 11.2 | 1 | 10.00 | 3.00 | 3.70 | 6 | 4 | 1.89 | 1.90 |
| ModelDeclarationIdling.cs | 224 | 112 | 2.7 | 2.7 | 1 | 12.00 | 5.92 | 7.00 | 5 | 4 | 2.26 | 2.26 |
| ModelDeclarationIdling.cs | 78 | 49 | 0.0 | 0.0 | 2 | 4.50 | 2.44 | 2.67 | 5 | 4 | 2.46 | 1.58 |
| ModelDeclarationElectricSystem.cs | 91 | 44 | 0.0 | 0.0 | 2 | 3.00 | 4.83 | 4.00 | 5 | 5 | 2.25 | 2.50 |

| Class | Method Name | Comple | Statements | Maximum Depth | Calls |
|--------------------------------|---|--------|------------|---------------|-------|
| AMTShiftStrategy | ShiftRequest(Second abs Time, Second dt, NewtonMeter or Torque, Pe... | 20 | 51 | 6 | 5 |
| AMTShiftStrategy | IntGear(Second abs Time, Second dt, NewtonMeter or Torque, PerSeco... | 17 | 26 | 6 | 8 |
| PowertrainBuilder | BuildFullPowertrain(VectorRunData data) | 16 | 50 | 6 | 23 |
| DriverModeStrategy | UpdateDrivingCycleData(DeclarationDataAdapter) | 15 | 23 | 6 | 6 |
| DriverModeBrake | DoHandleRequest(Second abs Time, Meter ds, MeterPerSecond targetV... | 15 | 34 | 5 | 52 |
| Gearbox | RequestGearEngaged(Second abs Time, Second dt, NewtonMeter or To... | 15 | 39 | 4 | 15 |
| DistanceBasedDrivingCycle | DoHandleRequest(Second abs Time, Meter ds) | 13 | 20 | 7 | 14 |
| ModalResults | ReadFromRaw(string fileName) | 13 | 20 | 6 | 22 |
| Driver | SearchOperatingPoint(Second abs Time, Meter ds, Radian gradient, Mete... | 12 | 44 | 4 | 50 |
| SummaryFileWriter | WriteFullPowertrain(IModalDataWriter data, string jobFileName, string job... | 12 | 56 | 3 | 72 |
| DriverModeDrive | DoHandleRequest(Second abs Time, Meter ds, MeterPerSecond targetV... | 10 | 16 | 5 | 28 |
| SI | SI(SI a, double? factor = null, Unit? fromUnit = null, Unit? toUnit = null, bo... | 10 | 25 | 5 | 9 |
| DistanceBasedDrivingCycle | DoCommitSimulationStep() | 10 | 12 | 4 | 10 |
| Driver | DrivingActionBrake(Second abs Time, Meter ds, MeterPerSecond nextTa... | 10 | 38 | 4 | 34 |
| CombustionEngineData | GetHashCode() | 10 | 10 | 3 | 9 |
| VehicleContainer | AddComponent(VectorSimulationComponent component) | 10 | 28 | 3 | 1 |
| DriverModeDrive | CheckRequestDoesNotExceedNextAction(Second abs Time, Meter ds, ... | 9 | 20 | 5 | 5 |
| EngineOnlyDataParser | Parse(Data table table) | 8 | 17 | 6 | 21 |
| VectorRun | RunInBackgroundWorker(worker = null) | 8 | 38 | 6 | 18 |
| DeclarationDataAdapter | CreateAuxiliaryData(Enumerable<VectorRunData.AuxData> auxList, Misc... | 8 | 23 | 5 | 5 |
| DeclarationDataAdapter | CreateGearboxData(GearboxFileVSDeclaration gearbox, CombustionEng... | 8 | 22 | 4 | 22 |
| VectorCSVFile | ReadData(string[] data, bool ignoreEmptyColumns = false, bool fullHeader... | 8 | 20 | 4 | 19 |
| DefaultDriverStrategy | GetNextDrivingAction(Meter ds, Distance) | 7 | 17 | 5 | 13 |
| DefaultDriverStrategy | Request(Second abs Time, Meter ds, MeterPerSecond targetVelocity, Ra... | 7 | 20 | 5 | 9 |
| Driver | SearchBrakingPower(Second abs Time, Meter ds, Radian gradient, Meter... | 7 | 35 | 5 | 33 |
| AuxiliaryTypeHelper | Parse(string s) | 7 | 12 | 4 | 0 |
| AuxiliaryTypeHelper | ToString(AuxiliaryType t) | 7 | 12 | 4 | 0 |
| CombustionEngineIdleController | Request(Second abs Time, Second dt, NewtonMeter torque, PerSecond ... | 7 | 26 | 4 | 14 |
| DrivingCycleDataHeader | FilterDrivingCycleEntries(List<DrivingCycleData.DrivingCycleEntry> entries) | 7 | 24 | 4 | 12 |
| EngineeringDataAdapter | CreateGearboxData(GearboxFileVSEngineering gearbox, CombustionEng... | 7 | 25 | 4 | 13 |
| EngineOnlyDataParser | ValidateHeader(string[] header) | 7 | 9 | 4 | 12 |
| FullLoadCurve | FindMaxPower(FullLoadCurveEntry p1, FullLoadCurveEntry p2) | 7 | 17 | 4 | 11 |
| ModalDataWriter | Finish(VectorRun.Status runStatus) | 7 | 14 | 4 | 15 |

Figure 4: Screenshots of code metrics (SourceMonitor): Checkpoints over time (top), list of classes sorted by complexity (middle), List of methods sorted by complexity (bottom)

2 How to Submit a Bug Report

In case you encounter a bug or Vecto 3 is not behaving as you would expect it is of utmost importance that the developers can reproduce your results². All bugs should be submitted as Jira Issue (either *Bug* or *Feature/Task*) to maintain traceability.

Every bug-report should contain a detailed description containing:

- What did you do
- What is your expected outcome
- What is the actual outcome
- Which Vecto version did you use? (Version number and Build number)
The version number is printed when you start vectocmd in verbose mode
- Screenshots if necessary

In addition a detailed log of your simulation is necessary. Please follow these instruction to create a log-file and the mod-files:

- **Start a command-line**
Press *Windows-r* and type `cmd`, change to the directory where you extracted Vecto 3.0
- Delete old log-files:
`del logs*`
- Start the simulation using Vecto-Commandline:
`vectocmd.exe -t -vvvv -mod <jobfile.vecto>`
it is important to use the option `-vvvv` and `-mod` which enable verbose logging and output of the mod-data file (`.vmod`).
If logging is enabled, the simulation runs are executed sequentially. If the error occurs only in some simulation runs (i.e., driving cycle and loading) you can cancel the other simulation runs by pressing *Ctrl-c*. (Note: if verbose logging is enabled the simulation takes much longer)
- File a new Jira issue³ with a detailed description (see above)
- Attach all data necessary to reproduce your results to the Jira issue, or if the data is confidential you can directly send it to the developers.
 - All input files
 - All Log-files in the directory `logs` (compressed)
 - Mod-files (stored in the directory of the Vecto job)

²<http://www.chiark.greenend.org.uk/~sgtatham/bugs.html>

³<https://webgate.ec.europa.eu/CITnet/jira/secure/CreateIssue!default.jspa>