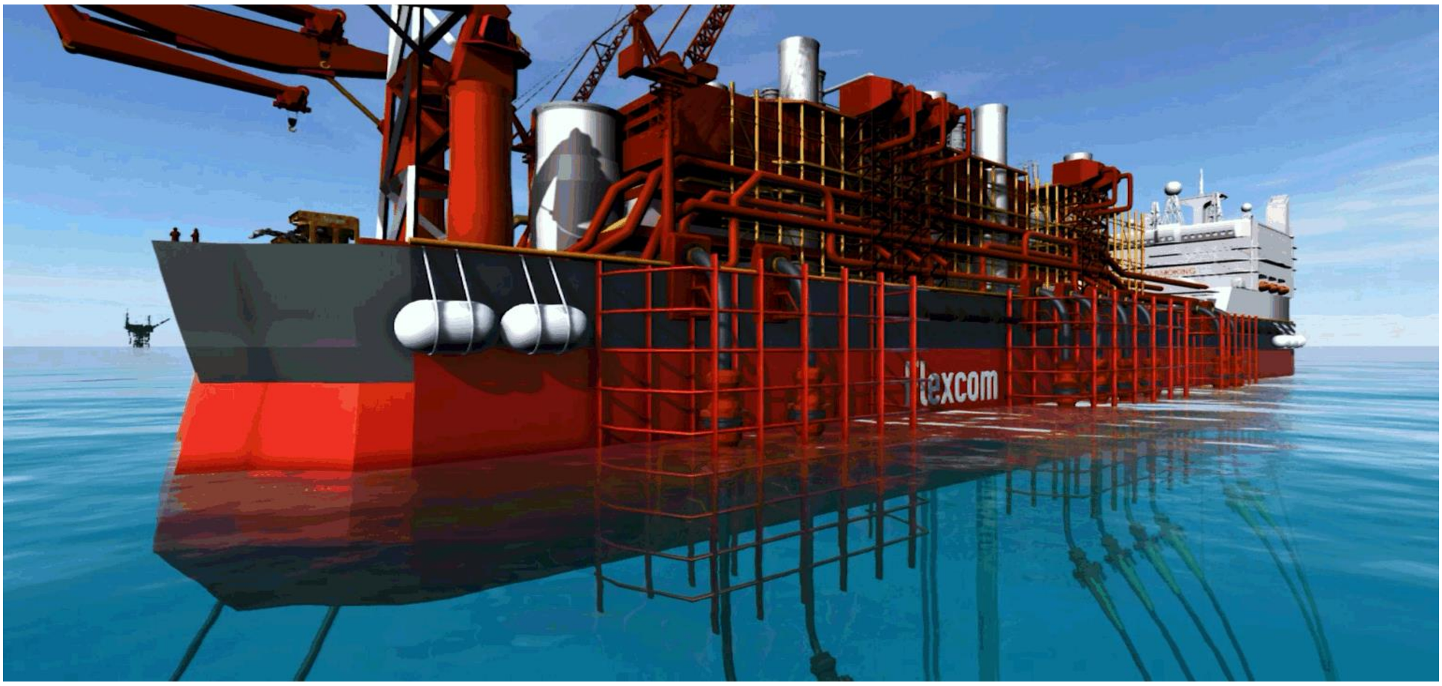
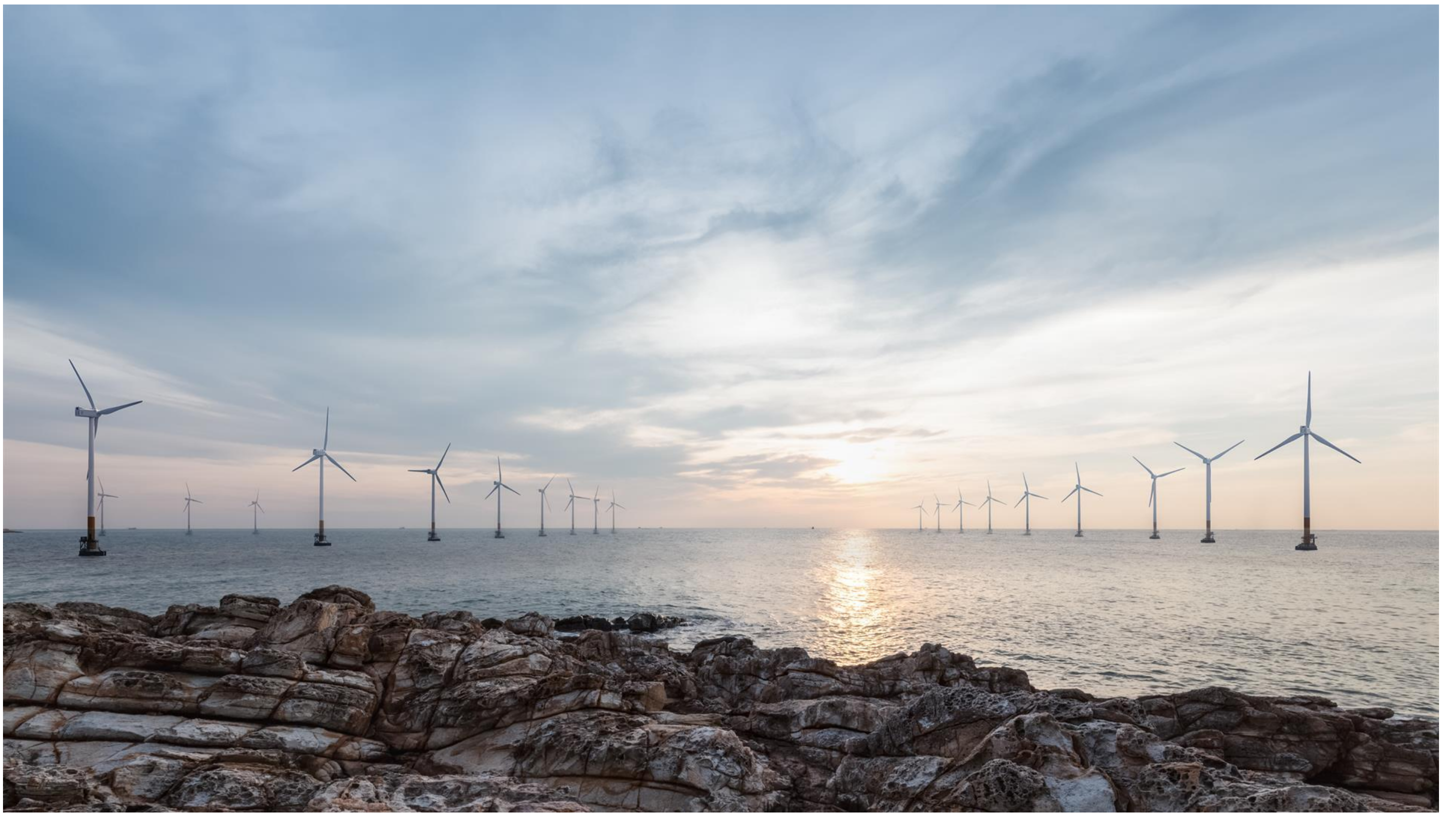
Flexcom

Advanced marine engineering simulation software

October 2021





A software newsletter by Wood

WELCOME

Aengus Connolly
Flexcom Product Manager

I am pleased to announce the release of Flexcom 8.13.

As with all software updates, the content of this new version is very much guided by user feedback. We received many helpful suggestions from our users and our focus has been on delivering new features in the areas where you need them most.

We have advanced our modelling capabilities in offshore wind and given the predicted exponential growth in floating offshore wind in particular, numerical modelling tools like Flexcom will be required to support detailed engineering design.

Like so many other desktop software packages, Flexcom's future is on the cloud. So, we are putting the necessary architecture in place now to allow you to avail of cloud computing services, whenever you choose to do so.

We welcome your continued feedback on Flexcom, it is an essential part of our software development process. So please feel free to contact me directly, you'll find my contact details below.

Enjoy working with Flexcom 8.13!

Kind regards
Aengus.

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Flexcom 8.13 Highlights

Offshore Wind
Aerodynamic modelling features are now fully available in Flexcom following successful completion of the software validation process. We've also updated our aerodynamic solver (developed by NREL) from FAST 8.16 to OpenFAST 2.6.0.

Flexcom-on-the-Cloud
Flexcom is now available on the cloud via our AppStream platform.

Numerical Solver
- Display of iteration progression in the Model View for non-converged solutions
- Default numerical integration scheme is Generalised-α, controlled via optimised coefficient for the spectral radius at infinity (ρ_∞)
- Critical Euler load monitored in elements experiencing compression

Post-processing
- Reduced database sizes, by storing data at 1, 2 or 4 points per element
- ISO-13628-7 (completion/workover riser systems) now supported
- Seabed reaction forces available
- Nodal reaction forces available in local axis system
- Completion status of all simulations included in post-processing and results collation
- General improvements to Excel output

New Examples
Flexcom 8.13 includes some interesting new examples, including two floating (semisub) offshore wind turbine, a fixed bottom jacket wind turbine and a wave measurement buoy.

Pipe-in-Pipe: VIV Fatigue
Flexcom offers a novel approach to estimate the VIV response of an inner pipe of a pipe-in-pipe system.

User Experience/Miscellaneous
Apart from the above, Flexcom 8.13 also provides a series of minor enhancements which will improve user experience

Fault Corrections
Flexcom 8.13 corrects a small number of program faults identified in the preceding version, Flexcom 8.10.4.

Software Installation

Flexcom 8.13 is now available for download from our website.

Download Flexcom

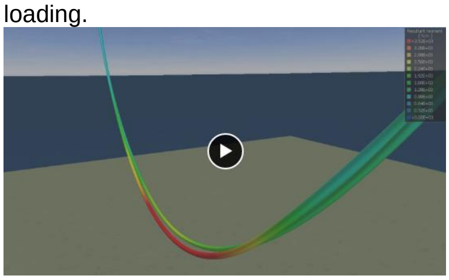
To install the upgrade, save the ZIP file to a temporary folder on your hard drive, unzip the contents, run 'InstallFlexcom.exe' to launch the Setup Wizard, and then simply follow the on-screen instructions.

Should you have any questions, refer to our Software Installation Guide, or Contact our Technical Support Team.

Contents

Join the Flexcom community!

We have over 2,200 followers on Linked In and we encourage everyone to sign up. You'll find some very interesting videos on the page, such as the one below which shows flexible risers crossing and becoming hooked together when a mid-water arch system is subjected to cross current and wave loading.

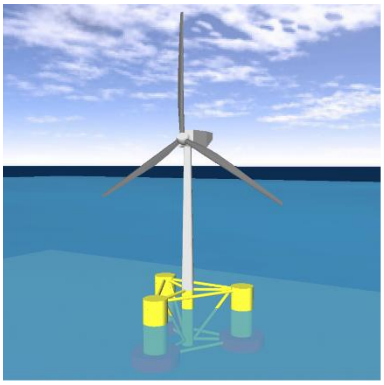


If you have an interesting model which you would like to share with the Flexcom community, please send it on to me.

Offshore Wind

Numerical simulation

Given the predicted exponential growth in floating offshore wind, numerical modelling tools like Flexcom will be required to support detailed engineering design. Flexcom has been coupled with the open-source aerodynamic modelling software OpenFAST, to enable it to perform fully coupled aero-hydro-structural simulation of offshore wind turbines. Previously available in a customised version, the modelling features are now available in the mainstream Flexcom product following successful completion of the software validation process (further details below). Modelling capabilities include:

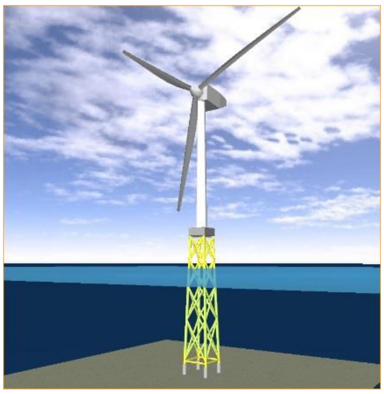


- Aerodynamics: generator power, generator torque, rotor speed & blade pitch
- Floating substructures: motion, velocity & acceleration in 6 DOFs, fairlead tensions & anchor loads, tower base moment, natural frequencies
- Monopiles & jackets: bending moments, shear forces, structural deflections, eigenfrequencies

Click here to read more details on the computational methodology.

Software validation

We have validated Flexcom against published data from the international research project OC4. Offshore Code Comparison Collaboration Continuation is a code-to-code verification project sponsored by the International Energy Agency (IEA) which benchmarks a range of simulation codes for offshore wind turbine modelling. Although Flexcom was no0t officially represented in OC4, we have retrospectively benchmarked it against publicly available data. Although primarily focused on a floating semi-sub in 200m of water, we also considered a fixed jacket substructure in shallower water, thereby illustrating the versatility of Flexcom to simulate fixed support structures in addition to floating. Click here to read our validation report for both models.



Flexcom is officially represented in the latest extension of this research work, OC6, via Queen's University Belfast who are using our software in OC6 Phase I. Click here to download the technical paper (free access).

Flexcom was used by Eolink to simulate their innovative floating wind turbine concept. Results from the numerical simulations were validated with empirical data derived from model-scale tank tests and sea trials. Click here and here to access the relevant technical papers (purchase required).

Flexcom-on-the-Cloud

Overview

Cloud computing has the potential to transform the way we perform engineering design. The digital revolution is providing companies with access to enormous amounts of data and computational power without costly capital investment in expensive IT hardware. Like so many other desktop software packages, Flexcom's future is on the cloud. So, we are putting the necessary architecture in place now to allow you to avail of cloud computing services, whenever you choose to do so.

We are building two separate delivery platforms for Flexcom:

- Portal: A fully automated solution which will handle everything from load case generation, running simulations, data storage and backups, post-processing and report generation. Structural designs and engineering report may be shared online by project engineers, giving a fully interactive and participative experience for the end client. Cloud machines are automatically created and destroyed as required by Flexcom, with no user intervention required.

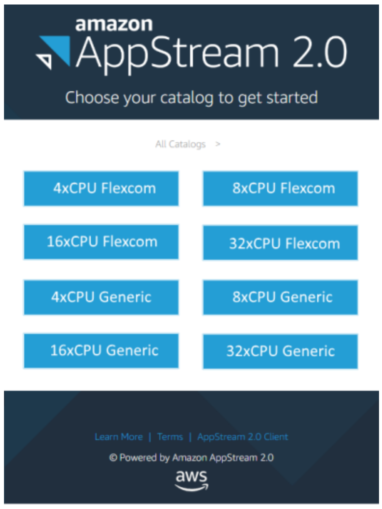
  The Portal is currently under development, and we hope to have further news regarding this very exciting and innovative platform in the near future.

- AppStream: A very useful platform which offers existing Flexcom users instant access to cloud computing. The Flexcom experience is exactly as before, but you are now using Flexcom within a web browser. AppStream is an abbreviation of 'application streaming' used by Amazon Web Services. Many users are already familiar with using Flexcom via remote desktop on a local server machine, so the experience will be intuitive to most. Unlike the Portal, you are responsible for selecting the number and size of cloud machines you require, managing data storage online, and shutting down the machines when your simulations are complete.

  AppStream is available right now. Click here to experience a free 1-hour session.

AppStream

This solution offers many benefits, including:



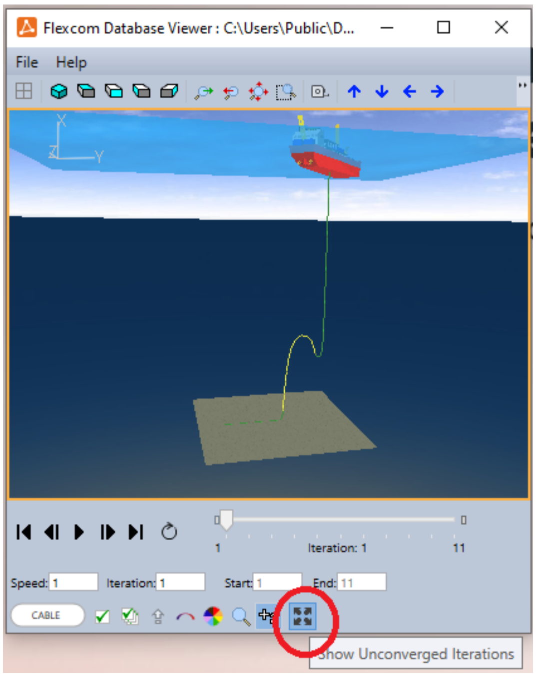
- Supplement your desktop licenses during busy periods
- Execute large batches of simulations in a short timeframe
- Safely archive your engineering data using secure cloud storage space online
- Manage software costs effectively via an hourly-based licensing system – pay only for what you use
- Receive email updates allowing you to accurately track software costs on a project-by-project basis

Ultimately, our vision is to deliver a fully automated cloud solution to our customers via the Portal. However, AppStream will appeal to many organisations as it cleverly bridges the transition from local servers to virtual hardware.

Numerical solver

Display of iteration progression for non-converged solutions

You can now visually inspect the progression of solution iterations via the Model View at the time when a simulation fails to converge. This could provide added insight which may help you to better understand the source of the non-convergence. It should be particularly beneficial for non-converging static analyses.

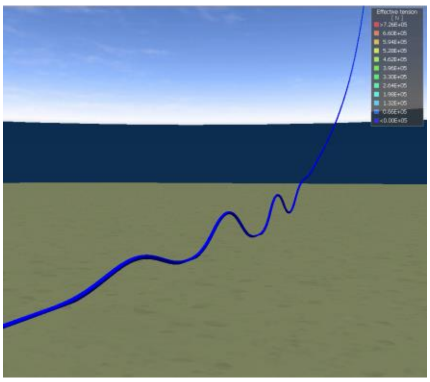


Numerical integration scheme

Generalised-α is now the default method for numerical integration in time. Although available in previous versions, Hilber-Hughes-Taylor remained the default up to this point. Investigations have shown that Generalised-α provides more effective numerical damping, particularly for sensitive models, hence the switchover. We have also introduced a single parameter, the spectral radius at infinity (ρ_∞) to simplify user control of the algorithm. Experience with Flexcom models suggest that $\rho_\infty=0.4$ is an optimal value which helps to ensure a robust temporal integration model without adversely affecting solution accuracy. The default values for the alpha-f and alpha-m coefficients in previous versions of Flexcom were not optimal.

Local buckling

Flexcom is capable of modelling buckling of a line section under compressive axial loads, provided that the relevant element lengths and the solution time-step are sufficiently refined. With regards to the element length, the critical Euler load is an important parameter. This is defined as the maximum compressive load which a beam can sustain without buckling laterally. Flexcom will issue a warning if the compressive load experienced in any given element exceeds the critical Euler load. Where this occurs, you are advised to use a refined mesh density in the region where the excessive compression is being experienced (the warning message will direct you to the relevant element number, and if you have built your model using lines, the line section in which it is located).



Post-processing

Reduced database sizes

Traditionally Flexcom has always stored results data at 3 points per element, namely the start, middle and end points. You can now choose whether you would like to store data at 1 (mid-points only), 2 (start and end points) or 3 (start, middle and end points) points per element. This option has the potential to greatly reduce the disk space, particularly for large load case matrices. *DATABASE CONTENT is used to control the number of data storage points.

Code checking

The range of engineering codes supported by Flexcom has been extended to include ISO-13628-7 (Completion/workover riser systems). *CODE is used to perform code checking, including the new ISO code.

Seabed reaction forces

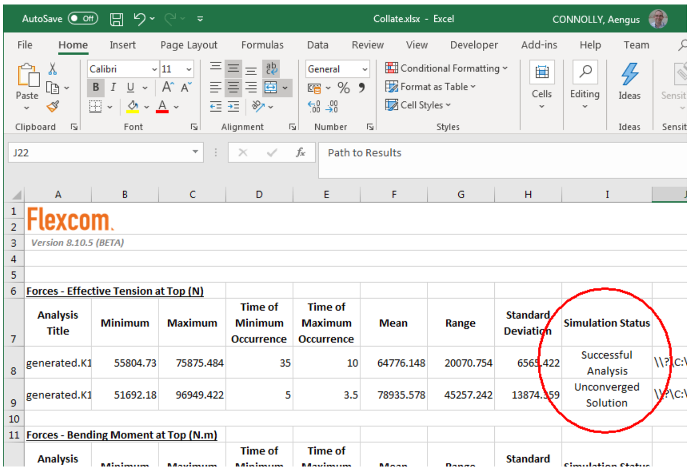
You can now examine seabed reactions using the Database Post-processor. Both time history (*TIMETRACE) and envelope (*STATISTICS) plots are available.

Nodal reaction forces in local axis system

Nodal reaction forces may now be obtained in a local axis system. This can be very useful when checking interface loads in the vessel axis system.

Summary post-processing & collation

Flexcom 8.13 informs you about the completion status of all simulations included in post-processing and results collation. Previously, if you had a large batch of simulations, and small number of these failed to complete successfully (e.g. due to convergence issues or solution indeterminacy), spreadsheet output would be generated as normal and you would most likely be unaware of any data which could be misleading.



General improvements to Excel output

Node and element label data is now included, for ease of reference to any lines used during model building. The overall layout of data has also been improved for better user experience.

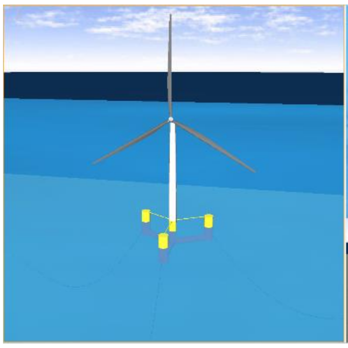
New Examples

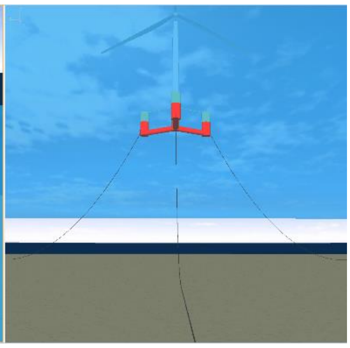
Floating Wind: OC4 Semi-sub

This example considers a floating semi-submersible platform in 200m water depth hosting a 5MW turbine, which is the reference model used in OC4 Phase 2.

Floating Wind: UMaine VolturnUS-S Semi-sub

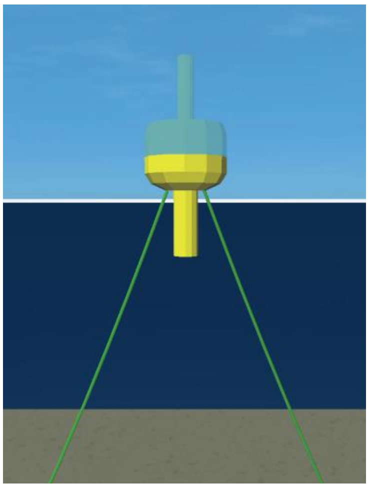
The University of Maine VolturnUS-S reference semi-submersible, a generic steel version of the UMaine patented concrete floating foundation technology developed in collaboration with the U.S. Department of Energy. The platform hosts the IEA Wind 15MW wind turbine which was jointly developed by the National Renewable Energy Laboratory (NREL) and the Technical University of Denmark (DTU).





Fixed Wind: OC4 Jacket

This example considers a fixed jacket structure in 50m water depth hosting a 5MW turbine, which is the reference model used in OC4 Phase 1.



Wave Measurement Buoy

This example considers a wave measurement buoy in 40m water depth. It is based on a buoy which was deployed at the SmartBay test site, Ireland's national observation and validation facility for the ocean energy sector.

Pipe-in-Pipe: VIV Fatigue

A specialised case of VIV induced fatigue is that of pipe-in-pipe systems, where the VIV of the outer pipe forces the inner pipe to move accordingly. Given that the displacement and stresses in the inner pipe are effectively governed by the VIV response of the outer pipe, it is not possible to estimate fatigue damage in the usual manner via Shear7. Instead Flexcom adopts a novel approach which involves the construction of regular/periodic time histories of bending moment, derived from the results of a static analysis of a riser system deformed into a specific mode shape, which are then post-processed by LifeTime in a manner similar to a random sea fatigue simulation. Click here to read more details on the computational methodology.

Miscellaneous

In addition to the significant new features documented above, Flexcom 8.13 also provides a range of more minor but highly practical additions which contribute to improved user experience. Click on the relevant hyperlink if you would like further information on any particular item.

User Plug-ins

You can now vary water depth and density during a simulation. This could be useful for shallow water scenarios where tidal variations can be important. *USER SOLVER VARIABLES and *USER DEFINED ELEMENT provides you the ability to define custom code for increased modelling flexibility.

Stress histograms

LifeTime now presents stress histograms based on the statistical and spectrum fatigue methods, in addition to the existing histogram based on Rainflow cycle counting.

Hydrodynamic Data Importer

This helpful tool has been updated to read in displacement RAOs for displacement driven simulation, in addition to the information required for coupled simulations like force RAOs, QTFs etc. OrcaWave has been added to the list of software programs supported.

Wave Kinematics

Several useful options have been added, namely the ability to assign scale factors to water particle velocities and accelerations and specify whether drag loading is to be based on absolute or relative velocities.

Web-Hosted Licenses

Static analyses are generally very quick to execute. If you are running a series of static simulations with Flexcom 8.10.4, the Network Licensing Client app is continually obtaining and releasing license seats at a high frequency. With a web-hosted license, this results in a high volume of calls between the client app (which sits on your desktop machine) and the license provider's server machine (which is obviously in a remote location). If there is any connectivity issue between the user PC and the online license provider, the license request may not be answered promptly, and Flexcom will report a message stating that the license is not available. This can be a source of inconvenience, particularly if you are running a large batch of simulations. This aspect has been improved considerably in Flexcom 8.13, which instructs the client app to run in 'manual mode' at the beginning of each analysis job. This ensures that the license is locked to your machine for the entire duration of the analysis job, regardless of the number of simulations involved. This reduces the number of online calls to the license provider (from potentially thousands) to just two – one to request a license at the beginning of an analysis job, and one to release it afterwards.

Floating body

The default duration for computation of retardation functions is now 100s, as the amplitudes have typically decayed away to insignificant values by this point. Previously the program computed the memory functions over the entire simulation duration, unless a shorter time was explicitly specified by the user, leading to inefficient computations and unnecessarily long run times.

The default position for the computation of force RAOs is now original rather than instantaneous. The original position is the correct one to use to ensure first order forces are computed correctly. Using the instantaneous position can introduce higher order effects which are undesirable and inconsistent with the radiation-diffraction potential flow theory. Experience suggests that it leads to Flexcom predicting excessive mean surge motions. However, there is one further complication. In random sea analysis, the platform will exhibit both high and low frequency movements (assuming QTFs have been specified). The first order forces should ideally be based on the instantaneous position caused by the second order effects only (but not include position due to first order effects). The rolling mean option could be used as an approximation, but ideally a low-pass filtering system is required. This will be developed in a future version but for now you are advised to use the original position in the computation of force RAOs.

64-bit Windows

Consistent with industry trends, Flexcom 8.13 is available as a 64-bit application only. Microsoft announced in May 2020 that it is no longer offering a 32-bit version of Windows 10 to hardware vendors. Given that most modern PCs, laptops and servers are running 64-bit operating systems, we are no longer offering a 32-bit version of Flexcom.

Fault Corrections

Flexcom 8.13 corrects a small number of program faults identified in the preceding version. Refer to the online documentation on Known Software Faults in Flexcom 8.10.4 for full details.