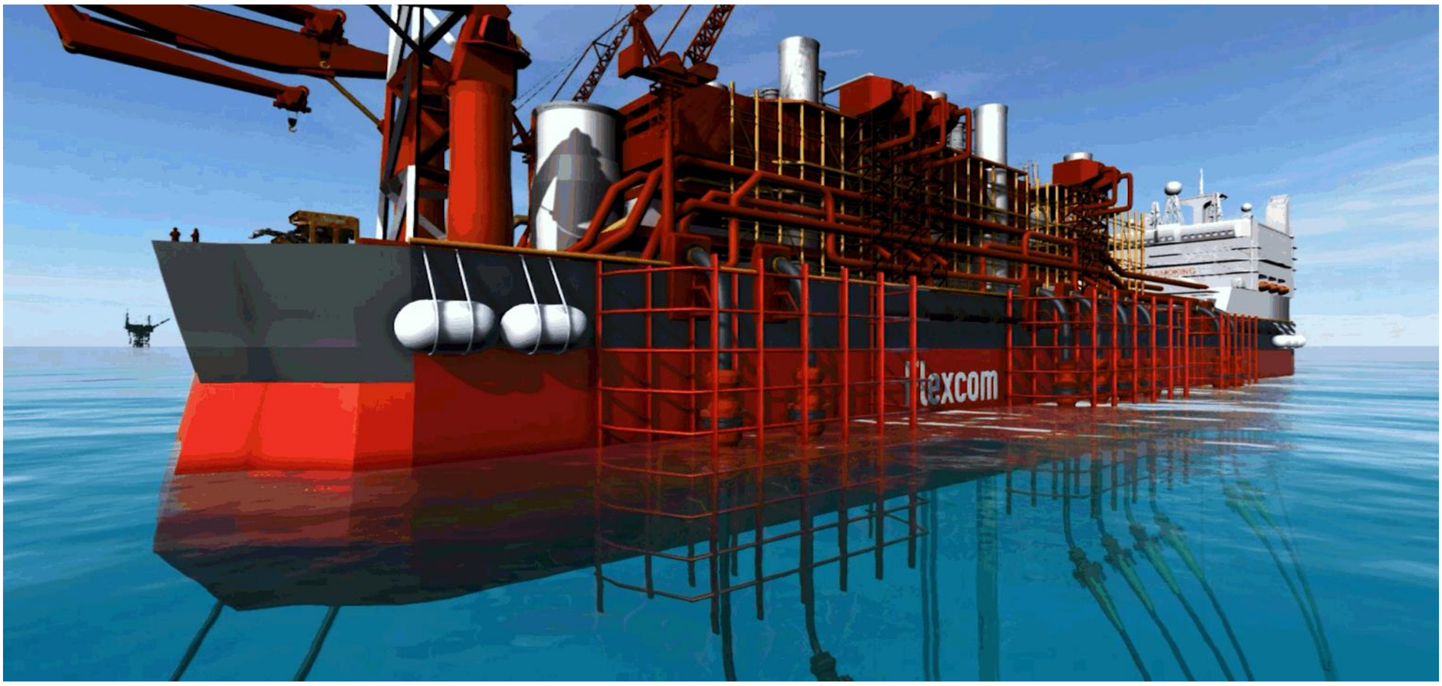
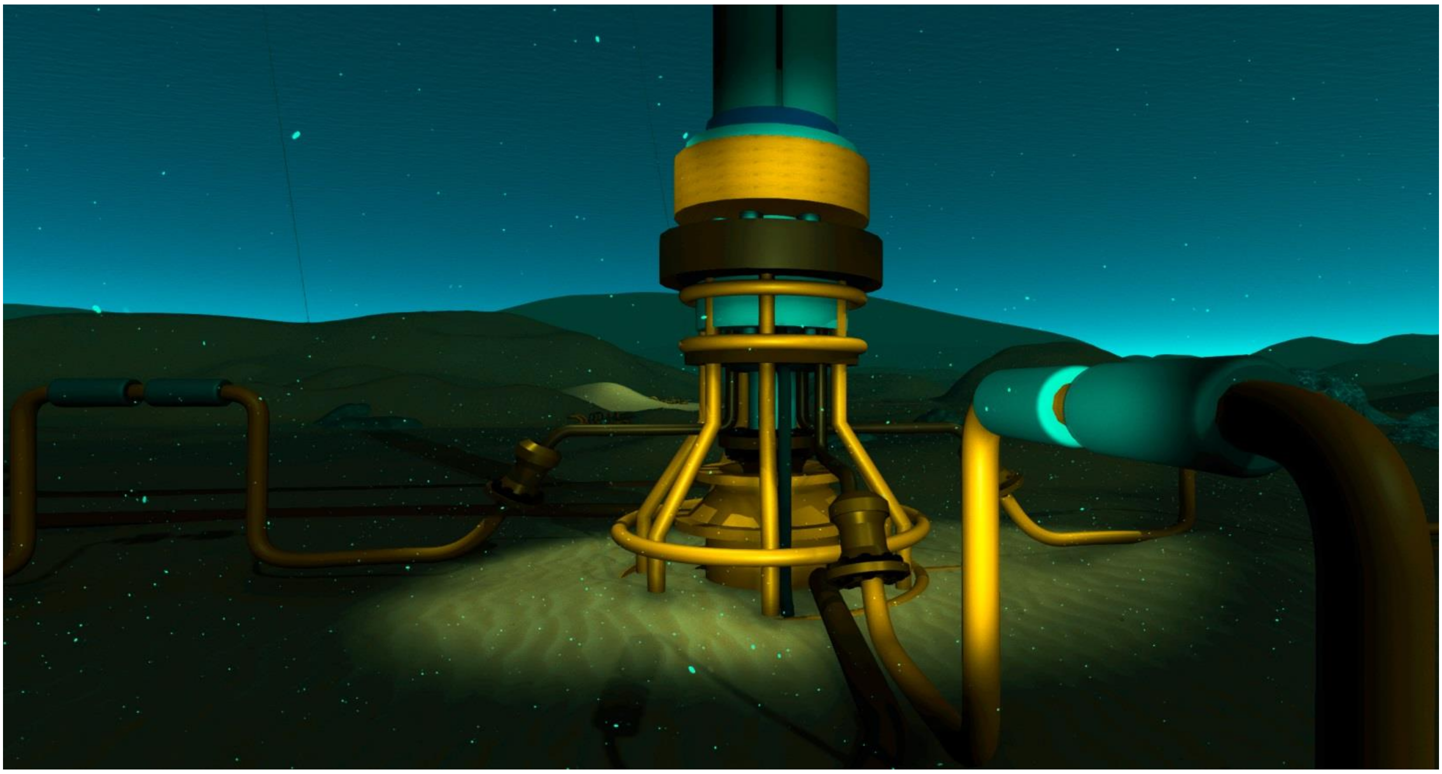
Flexcom

Advanced marine engineering simulation software

July 2018





A software newsletter by Wood

WELCOME

Aengus Connolly
Flexcom Product Manager

I am pleased to announce the release of Flexcom 8.10. This is a major release of the software which provides a number of significant technological advancements.

Guided by feedback from our global user base, we are proud to deliver a number of advances in key areas. For example, Flexcom now provides a metal plasticity modelling feature for the first time. We've also added a user-defined element which will facilitate advanced modelling scenarios for power users. The whole area of advanced graphics and virtual reality should interest most users!

User feedback is an essential part of our software development process. We invite you to join the conversation and welcome your opinions and suggestions which will in turn help guide future development. Feel free to call me at the number below, or simply email any suggestions to software.support@woodgroup.com.

I hope you enjoy working with Flexcom 8.10.

Best regards,
Aengus.

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Flexcom 8.10 Highlights

Metal Plasticity
Flexcom 8.10 sees the introduction of a metal plasticity model, capable of predicting plastic deformation and capturing residual strain, for the first time in Flexcom. Real-world applications include S-lay and reel-lay installation of pipes, and SCRs attached to large heave motion vessels.

User-Defined Element
This powerful new feature allows you to directly change elemental properties while a simulation is in progress.

Unity Plug-In
The Unity Plug-In allows users to create more advanced visualisations than is possible within Flexcom itself. Unity is capable of delivering photo-realistic graphics so this feature may be used to create promotional videos which highlight innovative device concepts or service offerings of engineering companies. Unity videos are also compatible with virtual reality, offering the viewer a fully immersive 3D viewing experience.

Hydrodynamic Data Importer
This utility program allows you to automatically import characteristic data relating to a floating body from a range of well-known hydrodynamic simulation packages, including WAMIT, ANSYS Aqwa and NEMOH.

Summary Wave Scatter
This feature offers an approximate solution of results for a full wave scatter diagram based on a selection of 'reference seastates'.

Cloud Licensing
Flexcom now provides an option to use a cloud-based licensing system. This offers additional flexibility to users by enabling ready to use licensing entitlements with less set-up overheads compared to traditional dongles. It also allows access to licenses outside of company networks.

New Examples
Flexcom 8.10 includes some interesting new examples, including a marine riser with an internal landing string deployment, and a steel pipe installation with plastic deformation.

User Experience/Miscellaneous
Apart from the above, Flexcom 8.10 also provides a range of less significant but highly practical additions which contribute to improved user experience.

Fault Corrections
Flexcom 8.10.1 corrects a small number of program faults identified in the preceding version, Flexcom 8.6.4.

Software Installation

Flexcom 8.10 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.

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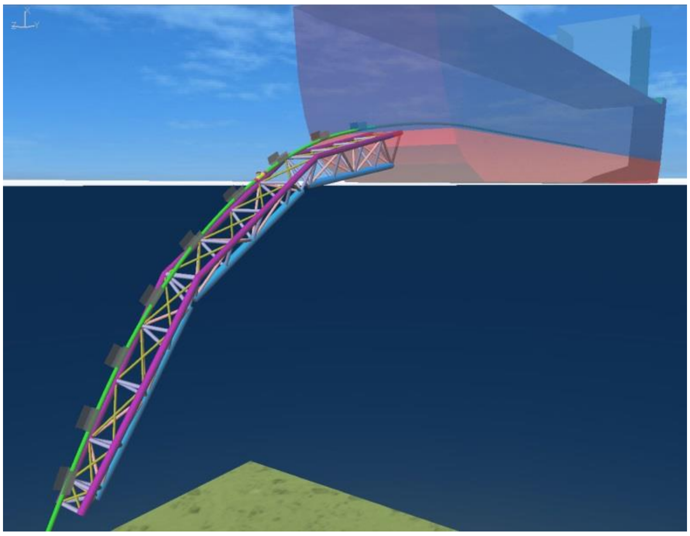
Metal Plasticity

Introduction

Flexcom 8.10 sees the introduction of a metal plasticity model, capable of predicting plastic deformation and capturing residual strain, for the first time in Flexcom. Steel pipes are widely used in the offshore oil and gas industry, and there are many instances of plastic deformation in real-world applications. For example, steel pipes installed via S-Lay stingers can experience plastic deformation in the overbend region. During reel-lay operations the pipe often experiences plastic deformation on the drum, before being subsequently passed through a straightening device. Steel catenary risers attached to large heave motion vessels may be susceptible to compression in the touchdown zone, which can in turn lead to localised plastic residual strain. Even drilling risers can occasionally experience plastic deformation, in situations where the drilling rig approaches the limits of its safe operating circle in severe weather conditions. Whether you are actively designing for anticipated plastic deformation, or simply wish to consider likely consequences in a 'what-if' scenario, the new modelling feature should be quite useful.

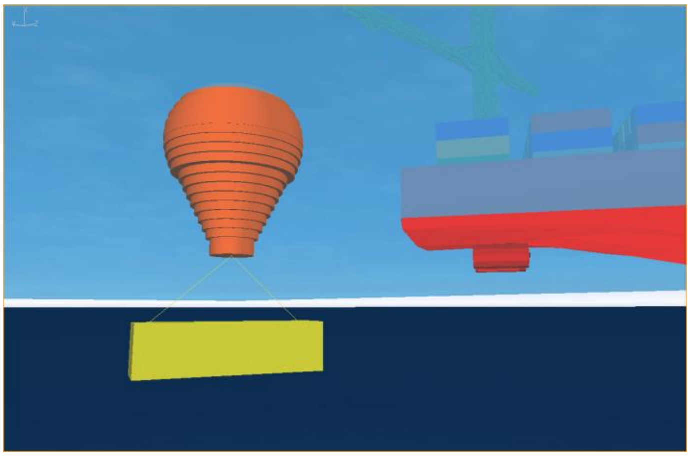


Theory

Flexcom uses a hybrid beam element, where constitutive equations are specified in terms of forces and moments and not stresses. There is no established measure of yielding expressed in terms of forces and moments. However *J2 flow theory* can be applied selectively to each mode of deformation to control the yielding independently. In this situation, the balancing of the beam capacity has to be performed explicitly. In other words, the bending, axial and torsion loading capacity of the beam must always sum to the same overall value. For example, should the beam become overstretched, then it cannot support the same bending moment as if it was not loaded at all. Adjusting the capacity is done automatically by the program, which assumes that torsion loads do not produce any plastic deformations. This is reasonable given the nature of the engineering problem, where bending and tensile loads would typically produce plastic deformations. It is considered that the bending moment capacity is dependent on the amount of resultant axial force in the cross-section, and which is calculated by integrating the stress-strain curve over the cross-section. The bending capacity is adjusted at least once at the beginning of an analysis for all beam elements in the model. These adjustments can be performed dynamically at the run-time if the tension changes by more than a specified amount. The plasticity model has been validated using a series of modelling scenarios where Flexcom is benchmarked against Abaqus. Learn More >

User-Defined Element

Using this new feature, you may redefine element properties (such as stiffness, mass, diameter and drag coefficients) by creating your own custom subroutine. You have access to a range of solution variables including nodal kinematic variables (displacements, velocities, accelerations) and elemental restoring forces (effective tension, bending moment, curvature, torque etc.). Equipped with this information it is then possible to directly change elemental properties while a simulation is in progress. The modified element parameters are passed back to Flexcom from this subroutine at the beginning of every solution step. Use of this feature requires some programming expertise, but it provides complete generality for power users to change elemental properties at any instant during the simulation. Some illustrative examples are provided to help upskill users and demonstrate the potential of this powerful modelling feature. Learn More >



Unity Plug-In

Overview

Flexcom 8.10 includes a Unity Plug-In application, which allows users to create more advanced visualisations than is possible within Flexcom itself. Unity is a gaming engine which is quite popular amongst video game developers. The plug-in transfers information from a Flexcom database into the Unity environment, which means that the enhanced display is based on the motions derived from the finite element Flexcom simulation. Unity is capable of delivering photo-realistic graphics so this feature may be used to create promotional videos which highlight innovative device concepts or service offerings of engineering companies. Unity videos are also compatible with virtual reality, offering the viewer a fully immersive 3D viewing experience. Experiencing a subsea model in 3D space provides an excellent sense of scale and perspective which is simply not possible from a flat screen monitor. Feedback from engineering teams suggests that this can be particularly important for subsea layouts where a number of components are operating in close proximity – in this case the spatial awareness afforded by VR can enhance engineering insight. Learn More >

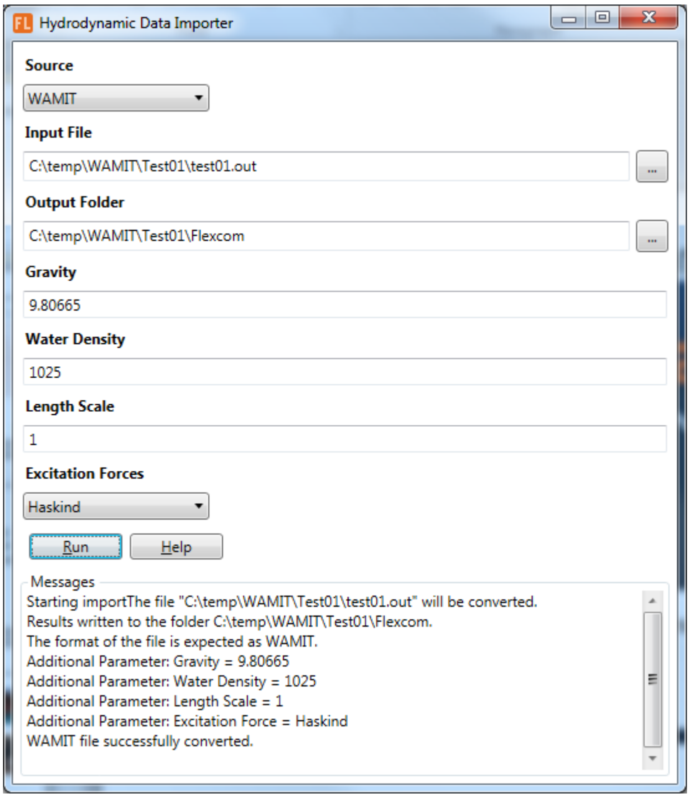
Interactive Demonstration

Virtual reality environments are normally provided by means of a specialised headset, which is supported by a high performance computer. However you can also experience a similar, albeit slightly lower spec version, using a standard smartphone and a cardboard headset. Open one of the links below on your smartphone using YouTube, set the view mode to 'Cardboard', set the quality to 'High Definition', and then pop on the cardboard headset. Once you're in the VR environment, you can adjust your viewing direction by physically turning around or looking up or down. We have created two separate locations for you to explore, one above the water surface and one subsea.

- Unity 360 Video – Vessel
- Unity 360 Video – Subsea

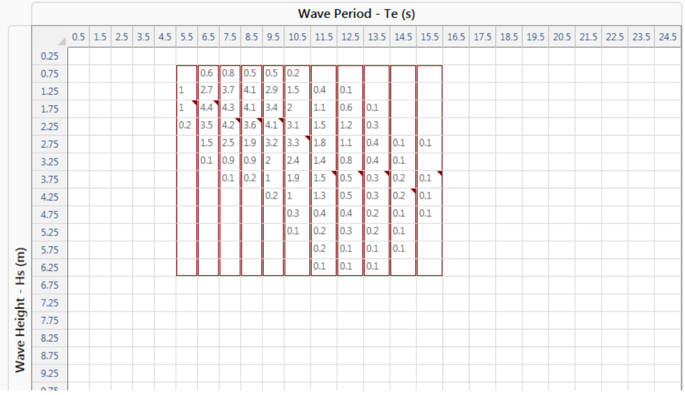
Hydrodynamic Data Importer

The *Hydrodynamic Data Importer* is a very helpful utility program which accompanies Flexcom 8.10. It allows you to automatically import characteristic data relating to a floating body from a range of well-known hydrodynamic simulation packages, including WAMIT, ANSYS Aqwa and NEMOH. Prior to the simulation of a coupled analysis in Flexcom, important hydrodynamic data is typically sourced externally from a radiation-diffraction program, and the importer aims to streamline the data transfer process, minimising both user effort and the potential for errors in data specification. Flexcom, like most other programs, has its own set of conventions regarding the specification of input data. The importer understands the output file formats and conventions used in several third-party software packages, and can automatically read in the relevant input data, perform the necessary conversions, and create output files which are readily accessible by Flexcom as standard input files. Learn More >



Summary Wave Scatter

Numerical simulation of an entire scatter diagram in the time domain can be quite computationally expensive, so the *Summary Wave Scatter* feature offers an economical extrapolation technique with a view to estimating the full results matrix based on a selection of 'reference seastates' within the scatter diagram. The scatter diagram is first sub-divided into 'blocks', where similar seastates are grouped together, before a single seastate is nominated as being representative for each block. Based on the numerical simulation results for the reference seastate within each block, the program fabricates a Summary Database File for each of the remaining cells within the block. You may then use Summary Postprocessing Collation as normal to collate results from all seastates. Learn More >



Cloud Licensing

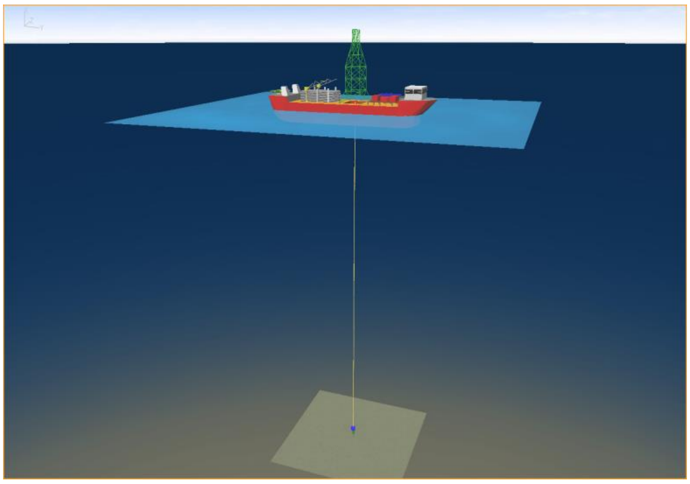
Flexcom now provides an option to use a cloud-based licensing system, also known as "Licensing as a Service" (LaaS). This system offers additional flexibility to users by enabling ready to use licensing entitlements with less set-up overheads compared to traditional dongles. Three licensing types are available with LaaS – perpetual, rental and token-based. Cloud-based licensing is where entitlements are stored and checked on the cloud, via an internet connection, and so it does not require the use of an on-site dongle to run the software. One of the added benefits of cloud-based licensing is that it offers the ability to use the software on any PC which has an internet connection, and so a user can access their licenses even when they are outside the company office or network.

The cloud based licensing system also provides a Pay-Per-Use (token based) license model to facilitate users in SMEs who do not need a full time rental license and may only need to use Flexcom on an ad-hoc basis. With this model users purchase a number of tokens upfront and then these tokens are consumed as the user performs simulations in Flexcom. The rate of token consumption is dependent on the type of simulation being performed (e.g. static, dynamic etc.). Learn More >

New Examples

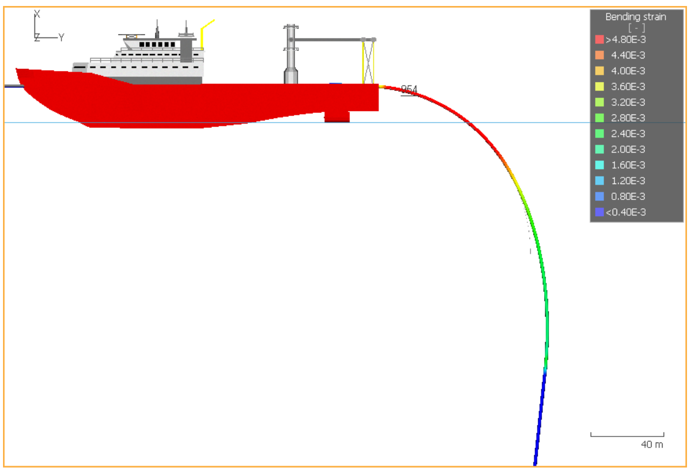
A05 - Marine Riser with Landing String

This example considers the deployment of landing string through a marine riser. The simulation is performed in a series of separate stages, considering different lengths of landing string deployed, in conjunction with various degrees of lateral vessel offset. The model is heavily parameterised, so template file readily accommodates any changes which may need to be made subsequently. For example, it's very easy to alter the number of joints present in the stack-up. Each riser joint is modelled in detail, including its bare, buoyant and flange sections. To achieve this effect, line section groups are used to automatically assemble the riser joint stack-up with relatively little effort required from the user. The initial model has 4 landing string joints included, corresponding to 56m of landing string. It is gradually lowered into the marine riser, by incrementally adding 4 new joints each time, until finally there are 32 joints present, corresponding to 448m of landing string. Lateral vessel offsets of up to 12m are considered, in increasing increments of 2m from the mean vessel position on station. Keyword based variations are used to define all the required parameters, as this facility is ideally suited to parameters which vary in fixed increments. Summary Postprocessing & Collation is used to examine flex joint angles, effective tension and bending moment, over the course of the deployment process. Learn More >



H05 - Steel Pipe Installation with Plastic Deformation

This example illustrates an installation scenario where a steel pipe is payed out over the vessel stinger and lowered onto the seabed. The pipe is supported by a flat guide surface which simulates the vessel deck level, while the stinger is modelled using a curved guide surface. A series of restart analyses are used to simulate the payout of the pipe over the stinger and down to the seabed. Once the pipe reaches the seabed, it is attached at that point, and the vessel is subsequently moved forward while further lengths of pipe are paid out.



Using envelope plots of plastic bending strain for all analysis stages, the location on the pipe which experiences the largest plastic deformation throughout the installation process is identified. Time history plots are then examined to provide further insights into the deformations experienced by the pipe during the installation process. Significant plastic deformation occurs when the pipe is deforming over the stinger under its own self weight. This strain subsequently reduces to zero as the pipe straightens out following the initial seabed contact. Ultimately the direction of curvature fully reverses from hogging to sagging and significant residual strain remains. Learn More >

User Experience/ Miscellaneous

In addition to the significant new features documented above, Flexcom 8.10 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.

Restart Analyses

Previous versions of Flexcom required that the start time for a restart analysis be equal to or greater than the end time for the previous simulation. This was cumbersome, particularly when restarting from quasi-static analyse which typically have quite a long duration. This restriction has now been lifted, so all simulations can start from time zero.

Pipe-in-Pipe Hydrodynamics

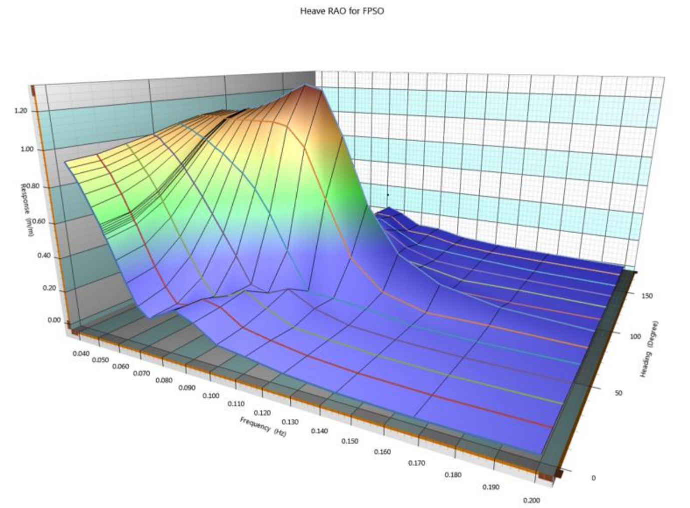
As mentioned in the Release Notes for Flexcom 8.6.3, the solution methodology for pipe-in-pipe hydrodynamics was updated to provide greater solution robustness and accuracy. Specifically the drag forces and hydrodynamic inertia on inner pipe-in-pipe elements are now modelled as terms on the left hand side of the equations of motion, capturing the required coupling between the outer node's velocity/acceleration and the inner node loading. However an inherent prerequisite for this modelling approach is that pipe-in-pipe connections exist in the global connectivity matrix, and such connections had to be explicitly created by the user, even if there was no physical connection between all outer and inner nodes. Flexcom 8.10.1 now automatically inserts token connections of zero stiffness if required to ensure that hydrodynamic loading on all inner nodes is modelled correctly.

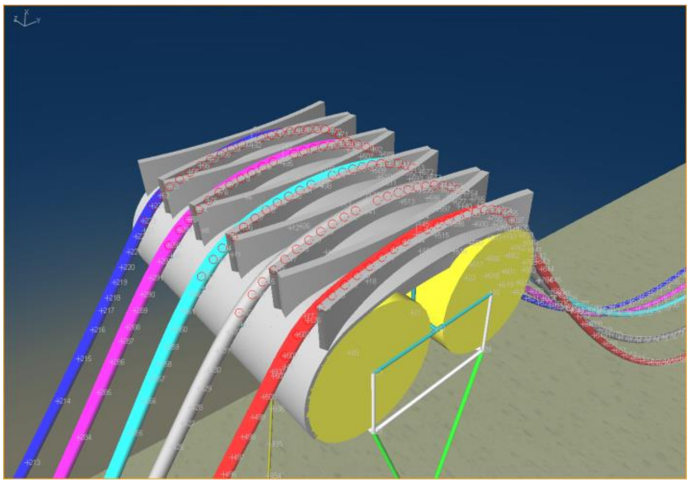
Post-processing for Vessel Motions

It is now possible to post-process directly for vessel motions in the local degrees of freedom (i.e. heave, surge, sway, yaw, roll and pitch). This is available via the TIMETRACE command in database post-processing. Earlier versions of Flexcom required you to create an additional (usually rigid and massless) element at the point of interest, apply vessel boundary conditions, and include this new element in the simulation.

Previewing Vessel RAOs

The RAO Response Plot feature now allows you to examine vessel RAO data as a function of both wave frequency and wave heading in a 3-dimensional space. You can still view the data in 2D mode if you prefer, in which case a separate data series is included for each wave heading, distinguished by a unique colour as noted in the plot legend.





Wave Origin

You can now explicitly specify an origin for the wave field, via the [WAVE-GENERAL]() keyword. Previously the wave origin was always located at Y=Z=0. This allows you for example, to obtain the same time history of water surface elevation at the vessel reference point, even for different values of vessel offset.

Shear7 Compatibility

Flexcom 8.10 is compatible with the most recent versions of Shear7, including Version 4.9 (released in 2016) and Version 4.10 (released in 2018).

Administrator Privileges

You may be aware that the [Job Execution Service]() is an intermediary entity which manages the interaction between the user interface and the finite element engine. The service is very useful as it allows you full control over the execution order of simulations, and more importantly if you need to reboot your PC for any reason while analysis jobs are in progress, the execution service re-launches itself upon restart and simply picks up where it left off. In exceptional circumstances, the user interface may lose connectivity with the service and stop receiving analysis status updates. Should this happen, the service must be rebooted manually, using via the traffic light icon. Earlier versions of Flexcom required administrator privileges to reboot the service, which meant calling it an IT person to assist, but Flexcom 8.10 allows anyone to perform this operation.

Summary Post-Processing

Summary output now includes nodal velocity and acceleration, in addition to nodal displacements, via the [PARA KINEMATIC]() keyword.

Model View

[Contact nodes]() are now highlighted in the Model View. Contact can occur with the seabed or guide surfaces, or via pipe-in-pipe connections. Once you switch on node numbers, contact nodes are designated by circular markers.

Fault Corrections

Flexcom 8.10.1 corrects a small number of program faults identified in the preceding version, Flexcom 8.6.4. The fault corrections are as follows:

Issue 1: Multiple Internal Fluid Assignment in Pipe-in-Pipe Models

- Location: [Pipe-in-Pipe Hydrodynamic Forces](), [Internal Fluid]()
- Severity: Minor.
- Description: A pipe-in-pipe outer section can only be associated with one internal fluid definition. If the outer element set contains elements associated with more than one fluid, then only the fluid properties associated with the first element in the outer element set are applied to the entire outer section.
- Workaround: Create a separate pipe-in-pipe section definition for each region of the outer pipe which contains a different internal fluid.

Issue 2: Sliding Pipe-in-Pipe Elements not Exposed to External Environment

- Location: [Pipe-in-Pipe Hydrodynamic Forces]()
- Severity: Major.
- Description: Sliding pipe-in-pipe elements which have experienced significant axial motion, such that they have effectively left the outer pipe section, remain subjected to the annular fluid hydrodynamics rather than the external ocean. This would be an unusual circumstance, experienced when an inner section is being inserted into a primary section (such as a J-Tube Pull-In), or being removed from it.
- Workaround: None.