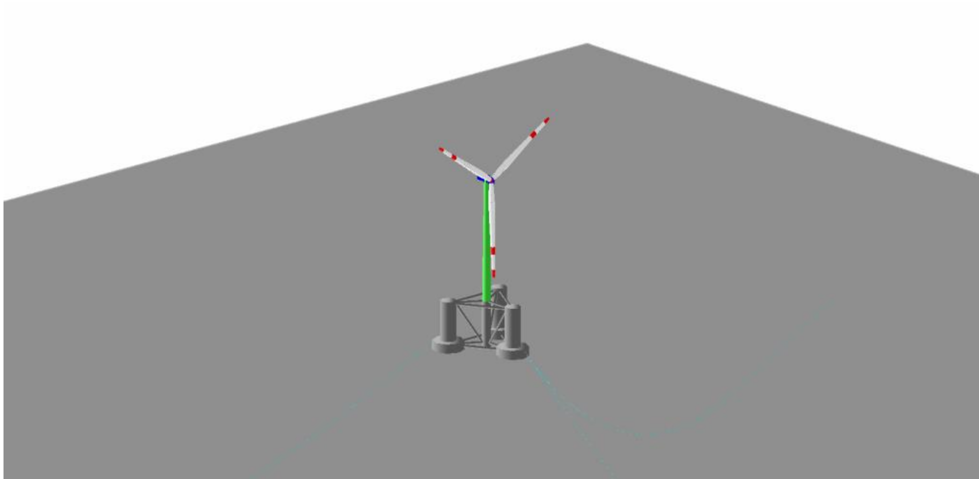

OCEANEWS

No 3

October 2016

Oceanira bulletin of technical and commercial information

R&D on floating wind

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Floating wind is finally a reality; with Statoil's Hywind, the first farm is going to be actually installed.

For many years floating wind turbines have been discussed, a number of research projects have been undertaken but only now it looks like this potentially significant renewable energy source is taken with the seriousness it deserves.

Three worlds are interacting closely: aerodynamics, hydrodynamics and structural dynamics. Most of the engineering companies involved in the "traditional" offshore world (oil&gas) have little or no idea of the specificities and technicalities involved in wind turbines design. Vice-versa, offshore environment and floating structures is not part of the background of wind turbines engineers.Part of the founding backbone of Oceanira is research & development and, to try bridging this know-how gap, we have decided to start looking into floating wind. Our perspective on the topic remains that of a naval architect/mooring/surf engineer and in our opinion some of the most relevant and important questions to give a proper answer to are:

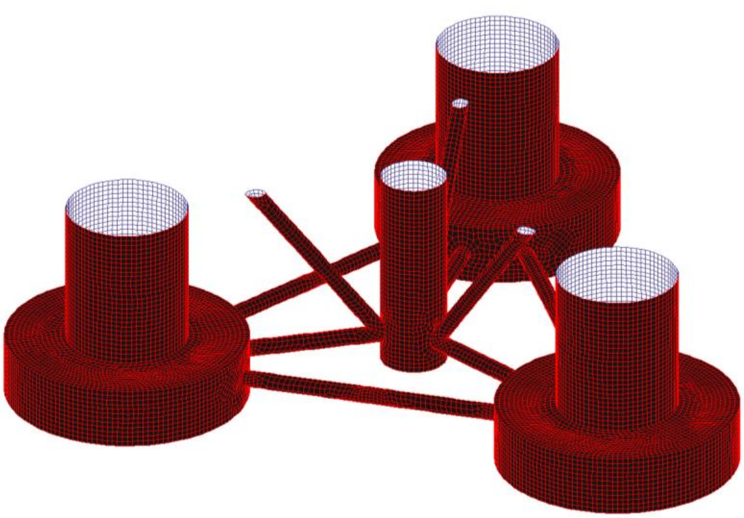
– how (and how much) does the wind turbine affect the dynamics of the floater?
– what is the degree of detail needed in the modelling of the wind turbine in order to have a proper representation of the loads transmitted to the structure below?

The reason why these questions arise is that building a global model including subsea (mooring & electric cable) floater and wind turbine may be either impossible (during a preliminary design or even FEED stage most of the turbine details are unknown and many software currently have no appropriate wind turbine modelling features) or nightmarish due to a lack of know-how or trickiness of the topic/inputs, such as:

– elasticity of the blades and aerodynamic effects due to their deformation;
– blade's pitch and turbine heading controls.

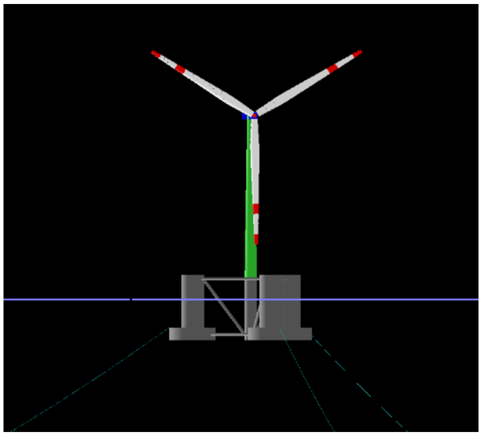
To address these and other questions appropriately, we have had the privilege to launch collaborations with the universities of Trieste and Genova (Italy) which, thanks to Principia SAS, have the opportunity to use the commercial software DeepLines™,including the specific module "Wind" which allows to model wind turbines in detail.

In particular, the questions raised above are currently being investigated by André Marra (student) and Gabriele Bulian (researcher and lecturer) at Università degli Studi di Trieste, in close



collaboration with Oceanira team, in the frame of a master degree thesis in naval architecture.
The global dynamic behaviour of a floating wind turbine (the NREL OC4 model has been used since for this structure most of the data are known and comparisons could be made with previous works) has been assessed and compared using different wind turbine modelling options, including rigid rotor blades with simplified pitch control and only mean thrust coefficients with no torque or gyroscopic effects.

The complete work and the results will be presented and discussed in the final thesis report but we may anticipate that, from a motion perspective, it appears that a number of simplifications can be introduced without compromising the global dynamic response of the structure. Certainly, any conclusion will need to be confirmed by similar studies on other type of floaters but for engineering companies which deal with hydrodynamics, moorings and cables, this seems a promising outlook.



Software development update

by Guido Rambaldi, Development Director
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Setting targets, studying, updating the targets: the basic loop for research.
One year ago, we kicked-off the R&D activities for technical software development and I believe that providing an overview of how the development loop has been updated could be interesting.
The core of the multibody quasi-dynamic hydro-mechanical time domain solver and simulator software has now a clear structure.
The software will be composed of three modules: a solution core, an advanced postprocessor and a graphical pre/post processor. So far, the development has involved the first module, the solution core. The solution core is fully independent and can be run without pre/post graphical pre-processor using an input text file; the graphical pre-processor will help inexperienced users creating the input file for the processor.
The keyword that can summarize the development and consequently the software is flexibility.
This is reflected in the input: the text will be made of sections and the files organisation leave lots of space for the user's preferences; the user will be able to subdivide the inputs in different files in order to structure and organize the data.

The simulation core reflects the concept of flexibility. All the solution combinations that we could possibly think of have been incorporated, allowing the user to select between a range of solution methodologies from the most complete and coupled to the most simplified one, passing by intermediate solutions where the different effects are included superimposing the motions time histories.
The software will allow to include:

– first order forces and motions;
– slow drift second order motions;
– high frequency second order motions.

solved in fully coupled, partially coupled and uncoupled modes. To do that, the software will have the possibility to solve up to four Runge- Kutta solvers at the same time.
To push to the extreme the concept of flexibility, we had "fun" when we decided to include the possibility to simulate bodies with variable masses, the physics of which is taken into account without significant simplifications. We thought that this could be useful to simulate big quantities of ballast released or unloaded quickly from a vessel during marine operations, for instance a fast lift. In this idea that can be seen as mad, we came across a quite long list of NASA reports that studied the problem (the "rocket equation"); hypothesis and simplification that are assumed in those papers can't be introduced in our case and consequently tailor-made motion equations have been developed.

OUR LATEST PROJECTS

Project	Client
FSRU Toscana - Side by side mooring and drift off analyses of 137,000m³ 155,000m³ LNG carriers	OLT S.p.A./ECOS S.r.l.
FSRU Toscana -Engineering and Procurement Services for Double bollard bitts, enclosed chocks and capstans Installation	OLT S.p.A./ECOS S.r.l.
Inland Navigation Barge - preliminary feasibility study for conversion	San Marco Shipping S.r.l.
R&D Offshore Renewables	OCEANIRA Internal R&D
MOSE project - Hydrodynamic analysis for lifting frame installation	Fagioli S.p.A.
MOSE PROJECT - Dynamic analysis for pneumatic support design	Fagioli S.p.A.

Welcome Aboard!

We are happy to announce that the Oceanira team and capabilities are expanding. We would like to extend a warm welcome to Eirini Spentza, a senior engineer with broad experience and focus in offshore engineering, who will collaborate with us on hydrodynamics and ship motion analyses and also expand our capabilities to the metocean sector.

Eirini obtained a civil engineering degree from Imperial College London and then went on to complete a PhD in wave mechanics and the nonlinear interaction of waves with fixed and floating structures. In 2010 she left the field of academic research and joined Noble Denton Consultants Ltd. (now trading as DNV GL), spending 6 years working on a wide variety of projects spanning between metocean studies and hydrodynamics of floating structures. We are very pleased Eirini is joining us, since her skills and capabilities complement and expand our services.

For the benefit of our readers we asked Eirini a few questions to give her the opportunity to present herself and her visions for the future of our collaboration.

G: Why join us?

E: I was attracted to the profile of the company, a small, flexible, dynamic enterprise, owned and run by the staff. Coming from a very large international organisation this is a much needed change and an area of growth and expansion for me. More responsibility on all levels, the added risk but also the independence to drive my professional life forward in the way I see fit. In addition, I know well the level of excellence that Oceanira upholds in all the technical work conducted, and the work ethos and mentality of the company which is very close to my own.

G: What are your key areas of interest?

E: Fundamentally, anything that floats and is in the sea. I've been on sailing boats since early childhood, and have a very strong personal connection to the marine environment. I love waves, which is what I did my PhD on. But also boats and floaters, of all shapes, sizes and functions. In fact what I'm most interested in is the joining of these two areas, metocean and floating-body hydrodynamics. Quite often these two aspects are separated, but there is a lot of added value to an offshore project when there is a close collaboration and synergy between the two.

G: What type of projects do you intend to engage in?

E: My previous experience is in the oil and gas industry, so the immediate involvement will be with this sector. I have a lot of experience in the metocean area, which I would like to develop further and build upon. The vision for the future is to move also into the renewable energy sector. I have always been very interested in wave energy converters, following that industry in its development. I'm keeping a close eye on these technologies and hopefully there will be a lot of expansion in this sector and interesting projects arising in the near future.

G: How do you foresee the development of your work inside Oceanira?

E: In my view there are three aspects to this. One of them is the commercial aspect of expanding the client basis and widening the range of projects that we presently engage in as a company. The other aspect is the continuous development of in-house tools especially in the metocean field, to be able to conduct work faster, with the highest level of quality, whilst remaining at the cutting edge of the field in terms of analysis methods. And the third aspect is the development of future areas of interest, such as renewable energy. This is a long term investment with an eye on the future.

G: Since I know that it's one of your favourite topics, what can you tell us about freak waves?

E: Freak waves often attract as lot of hype because of the terminology. In fact all it means is that these extreme wave events are outside of the statistical distribution that we expect, they are outliers so to speak. The most recent research conducted in the field as part of various joint industry projects, has demonstrated that there is no consistent difference between the sea states where "freak" waves arise, compared to "normal" sea states. What this tells us basically is that "freak" waves are a highly improbable occurrence within the same statistical distribution. The most widely accepted physical explanation for these events is that they occur due to a focusing of wave energy in one point in space and time. You can think of it as constructive interference, where the crests of all the wave components assumed to be making up the sea state happen to coincide, leading to a very large crest. Nonlinear interactions between the wave components, causing permanent changes and energy shifts within the wave spectrum, can further increase the crest height by 20-30% compared to a linear estimate. Hence the importance of considering at least second-order or fully nonlinear solutions when attempting to model such occurrences.

G.R./E.S.