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Wecpos – Wave Energy Coastal Protection Oscillating System: A Numerical Assessment

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In recent years, the interest in developing new technologies to produce energy with low environmental impact by using renewable sources has grown exponentially all over the world. In this context, the experiences made to derive electricity from the sea (currents, waves, etc.) are of particular interest.
At the moment, due to the many existing experiments completed or still in progress, it is quite impossible explain what has been obtained but it is worth mentioning the EMEC, which summarizes the major projects in the world.
Another important environmental aspect, also related to the maritime field, is the coastal protection from the sea waves. Even in this field, since many years, the structural and non-structural solutions which can counteract this phenomenon are analyzed, in order to cause the least possible damage to the environment.
The studies in development by the researchers of the University of Salerno are based on these two aspect previously presented.
Considering the technologies currently available, a submerged system has been designed, WECPOS (Wave Energy Coastal Protection Oscillating System), to be located on relatively shallow depths, to can be used simultaneously for both electricity generation and for the coastal protection using the oscillating motion of the water particles.
The single element constituting the system is realized by a fixed base and three movable panels that can fluctuate in a fixed angle. The waves interact with the panels generating an alternative motion which can be exploited to produce electricity.
At the same time, the constraint movement imposed for the rotation of the panels is a barrier to the wave propagation phenomena, triggering the breaking in the downstream part of the device. So the wave energy will be dissipated obtaining a positive effect for the coastal protection.
Currently, the efficiency and effectiveness of the system (WECPOS single module) has been studied by using numerical models. Using the FLOW-3D® software it has been possible to evaluate the hydrodynamic interactions that occur between a regular wave, with different height and period characteristics.
The RANS equations, coupled with the RNG turbulence model, have been integrated on a three-dimensional channel (90.0 x 6.0 x 8.0 m), using a numerical domain made of two mesh blocks: a general one containing the entire domain (cells size 0.30 cm) and the localized one on the device (cells size 0.10 cm).
With the results, by assessing the rotational angle, angular velocity, hydraulic torque of the individual panel it has been possible to estimate the potential energy production. A Matlab/Simulink model has been built to estimate the production of electric energy by means of an oleodynamic system consisting of a piston and a turbine coupled with an electric generator.
About the coastal protection, by estimating some characteristic parameters of the wave motion (zero-moment wave height Hmo, transmission coefficient Kt and the average free surface elevation), the behaviour of the WECPOS device has been analyzed for its ability in wave energy dissipation.