Navigational areas and marine objects modeling methods in contemporary Ship's Bridge Simulator

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Abstract: The The article presents vessels' models electronic databases construction for Świnoujście - Szczecin harbor in the MultiGen™ Creator v3.21 environment dedicated for maneuver - navigational simulator Polaris™ by Kongsberg Maritime AS.

1. Software environment and files format

1.1 Multigen Creator v3.21

Multigen is software for creating highly optimized high-fidelity real-time 3D content for use in visual simulations, specifically designed for real-time 3D simulation. Creator streamlines the modeling process and increases productivity by enabling effective creation highly detailed 3D models and digital terrains. The powerful plug-in architecture together with the integrated and extensible toolset provide interactive real-time 3D modeling power for creating precise visually exceptional content and synthetic environments.

1.2 SeaGen

The Creator plug-ins is a set of functions added to the standard MultiGen Creator and a set of data extensions that extends the flight format. The purpose is to add the functionality needed for building exercise areas for the Polaris simulator. The data extensions allow the user to add typical mariner object as for instance depth soundings and buoys to the database. Some of the functions are

very specific and use only for the Polaris Simulator. The plug-ins for Multigen Creator together with the standalone program Fltutil™ is called Seagen™ that is the tools needed for building exercise areas and saving its into "flt" extension for the Polaris™ Simulator.

1.3 Flight files

„Flt" format allows to integrate all the necessary information to generate the vector picture, made of layers, including numerical data and geometric objects' models for the needs of Polaris™ simulator.

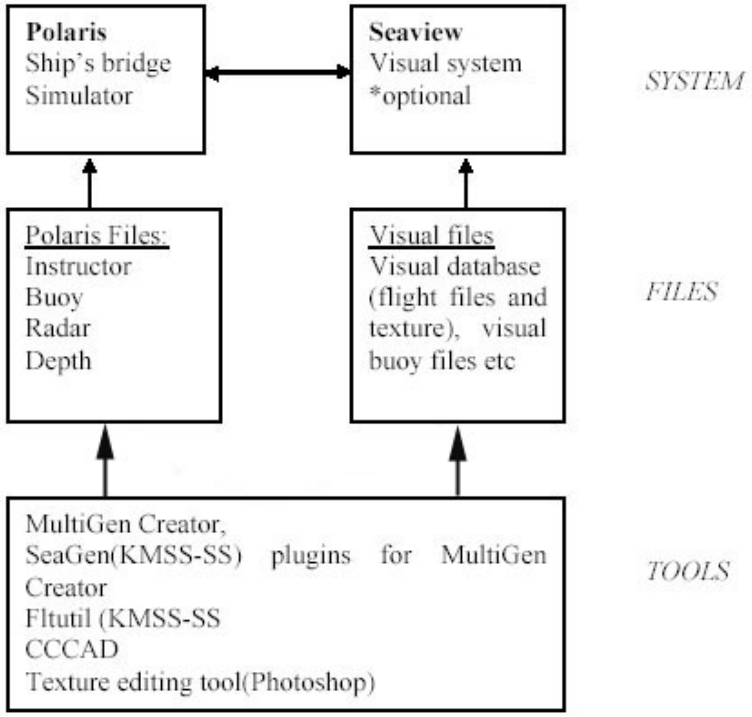

Fig. 1. Polaris™ ship model consolidation

"Flt" format can be transformed to other graphical formats of applications used in designing of 3D objects.

2. Visual marine objects modeling

The interaction between the visual system and the Polaris instructor is based upon predefined groups/object names in the flight database. Polaris sends the names and action to visual system that searches the database for the specific

names and performs the action. Additional actions are performed based upon the comment-records that are attached to the database-beads.

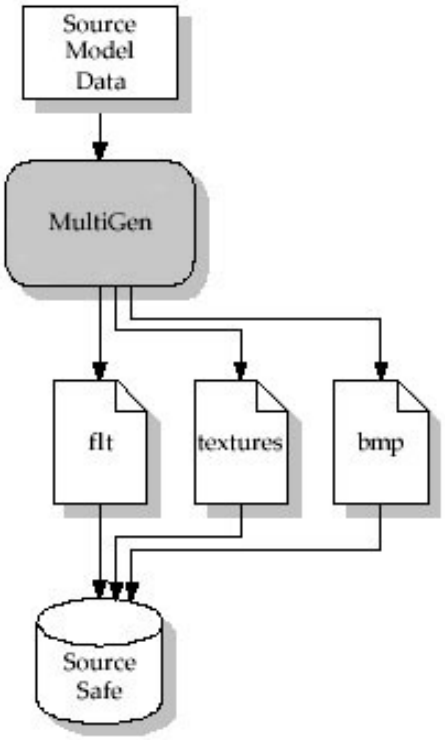

Fig. 2. Marine objects visual modeling

2.1 3D ship's model creation procedure

Basing on the collected construction data (shipyard documentation) we may sat about creating vessels' models in 3D graphics. Depending on complexity level we apply defined 3D solids available in the program or using grid we create out own shapes.

Process of vessels' models creation requires defining a number of parameters in Multigen Creator v3.21 program. Characteristic of an object that is formed, allows to implement it as an "ftl" file to the Polaris™ simulator. The hierarchy of the procedures-tree requires the following variables to be defined:

- ownship/target (the marine object is a ownship or a target)
- level of detail (LODs 1/2/3 – graphic details level)
- lanterns (STANDARD and SPECIAL faces)
- deck lights (lights faces)
- day symbols (symbols faces)
- flags (flags faces)
- waves (position of wave vertex)

- wakes (position of wakes vertex)
- moving objects (name of children objects with DOF)

2.2 Textures

When creating objects in 3D graphics, programmer is strongly limited by the computing power of visual computers, so the number of vertexes, faces of spatial elements have to be restricted to its minimum.
To create textures, photographs, pictures are used, as well as self-made compositions prepared in Adobe Photoshop™ program.
1-side faces are used to improve system efficiency.

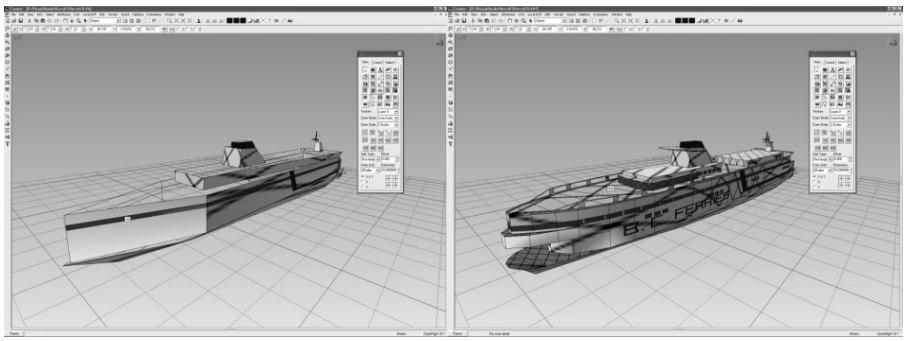

Fig.3. 3D model of Ferry (simply model and model filled with textures)

3. Digital databases preparation for Świnoujście and Szczecin harbor basins

3.1 Visual databases

Visual databases for Szczecin and Świnoujście harbors (so-called scenes in 3D computer graphics environment) were built basing on electronic maps in SENC standard by C-Map® , satellite photos and photos of specific objects including navigational marks, shoreline, wharfs, buildings, trans-shipment devices, trees, etc.
Databases covers the polygons defined by the following coordinates:

- Szczecin basin: SW: ϕ=53°23.9985'N, λ=014°31.3566'E
  NE: ϕ=53°37.1812'N, λ=014°44.9935'E
- Świnoujście basin: SW: ϕ=53°52.5008'N, λ=014°14.0001'E
  NE: ϕ=53°56.5003'N, λ=014°18.4989'E

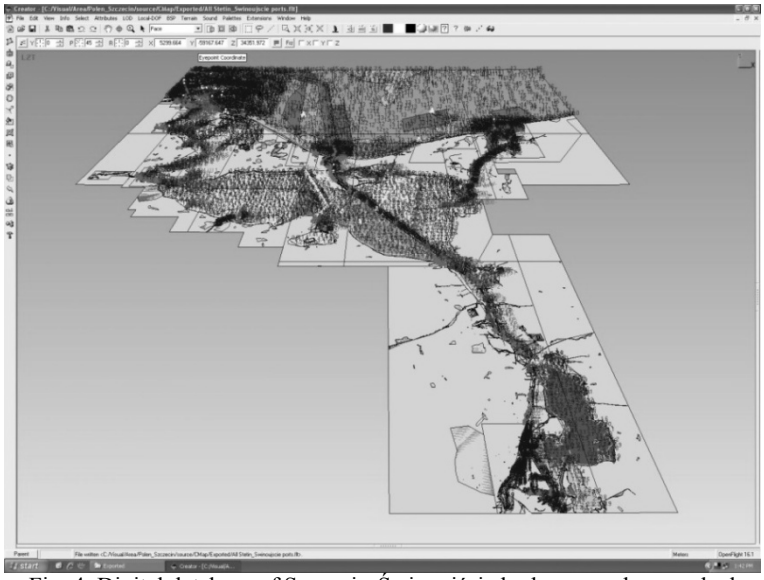

Fig. 4. Digital database of Szczecin-Świnoujście harbor complex, worked-out on the basis of SENC C-Map PL5SWINO (PORT OF ŚWINOUJSCIE), PL5SZCZE (PORT OF SZCZECIN)

Basing on the gathered data three-dimensional (3D) and two-dimensional (2D) models were created, filled with solid and transparent textures. Models included shorelines, land topography, as well as separate, specific harbor objects. Visual database consists of three main files, saved in MultiGen™ „flt" format: "Szczecin_Swinoujscie.flt", "Szczecin.flt", "Swinoujscie.flt".

Construction process for 3D models and their examples are presented on figures 5 to 8.

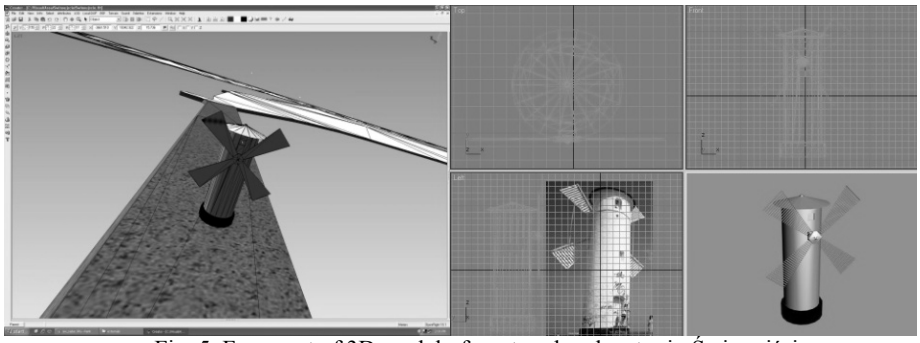

Fig. 5. Fragment of 3D model of western breakwater in Świnoujście, with leading-light, type "windmill"

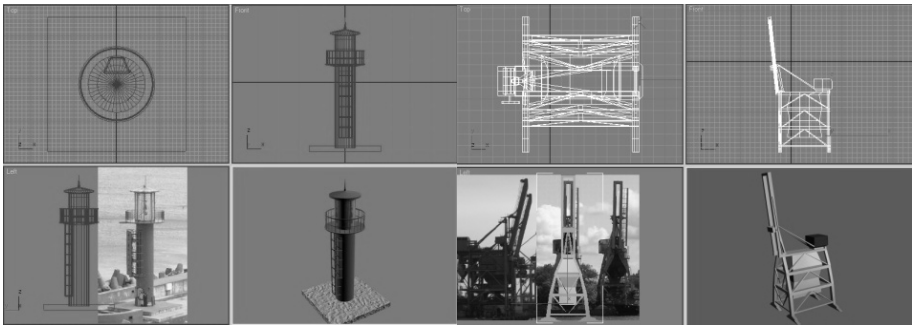

Fig. 6. 3D model of the navigational light on the eastern head of breakwater and derrick at the Górników Quay in Świnoujście

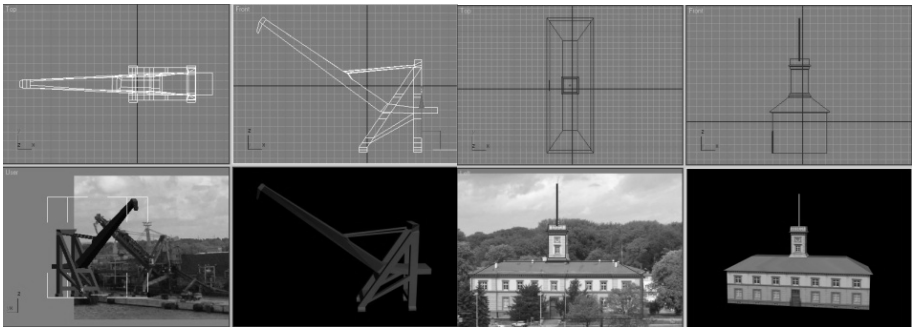

Fig. 7. 3D model of conveyor and town hall at the Kapitanat Portu Quay in Świnoujście

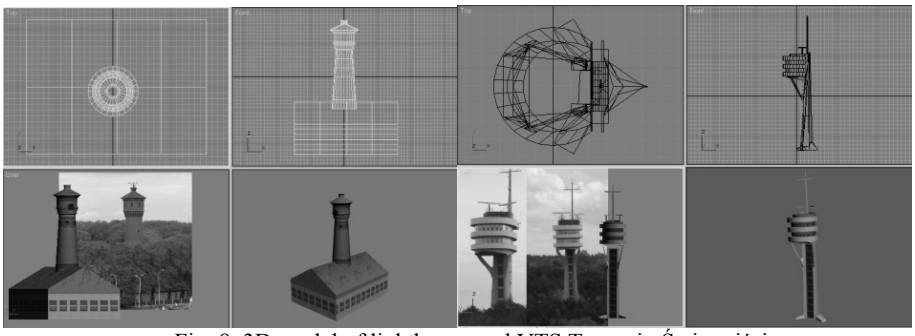

Fig. 8. 3D model of lighthouse and VTS Tower in Świnoujście

3.2 Depth databases preparation for Świnoujście and Szczecin harbor basins.

Depth databases for Szczecin and Świnoujście harbor basins were built basing on electronic maps in SENC standard by C-Map® and survey data of Maritime Office in Szczecin (in CAD format). Depth database consists of "dcs" files, exported from "flt" format.

Construction process of depth database is presented on figures 9 and 10.

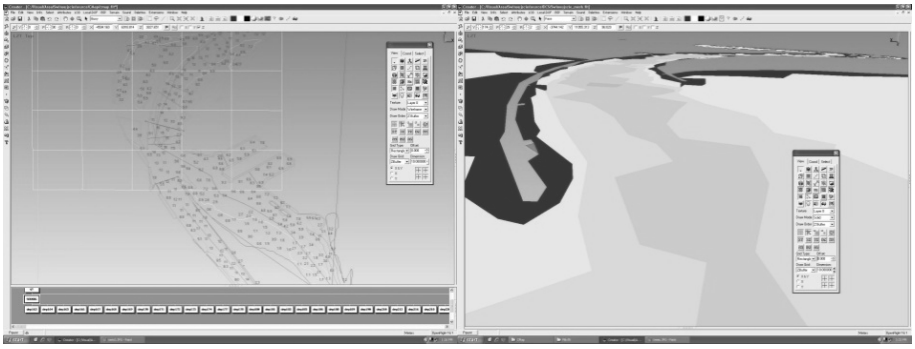

Fig. 9. Layer depth text visualization from survey database and 3D model of fairway in the heads of Świnoujście harbor (discretization 5m)

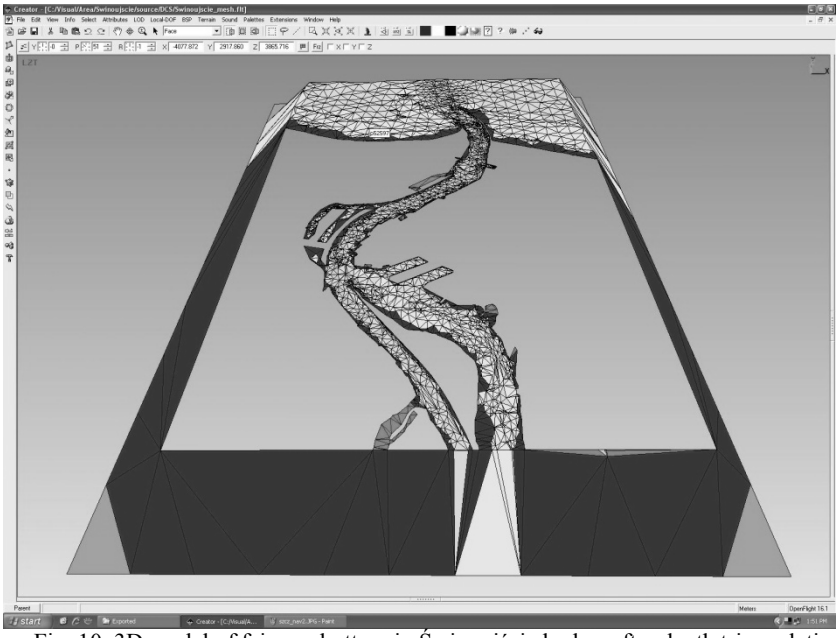

Fig. 10. 3D model of fairway bottom in Świnoujście harbor after depth triangulation

3.3 Navigational marks databases preparation for Świnoujście and Szczecin harbors.

Databases for navigational marks (buoys and lights) of Szczecin and Świnoujście harbors were built basing on electronic maps in SENC standard by C-Map® and data of Maritime Office in Szczecin. Database consists of "nav" files exported from "flt" format.

Construction process of navigational marks database is presented on the figures 11 and 12.

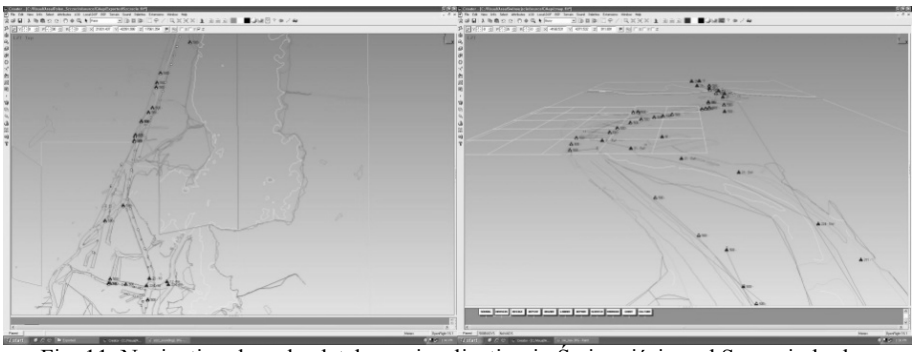

Fig. 11. Navigational marks database visualization in Świnoujście and Szczecin harbor

3.4 Radar databases preparation for Świnoujście and Szczecin harbor basins

Radar databases for Szczecin and Świnoujście harbor resulted from triangulation of objects located over the sea level from the visual bases of MultiGen™ environment. After exporting from "flt" format, target files have "rad" extension (real radar device) and "rdb" (simulated radar).
Construction process of radar database is presented on figure 13.

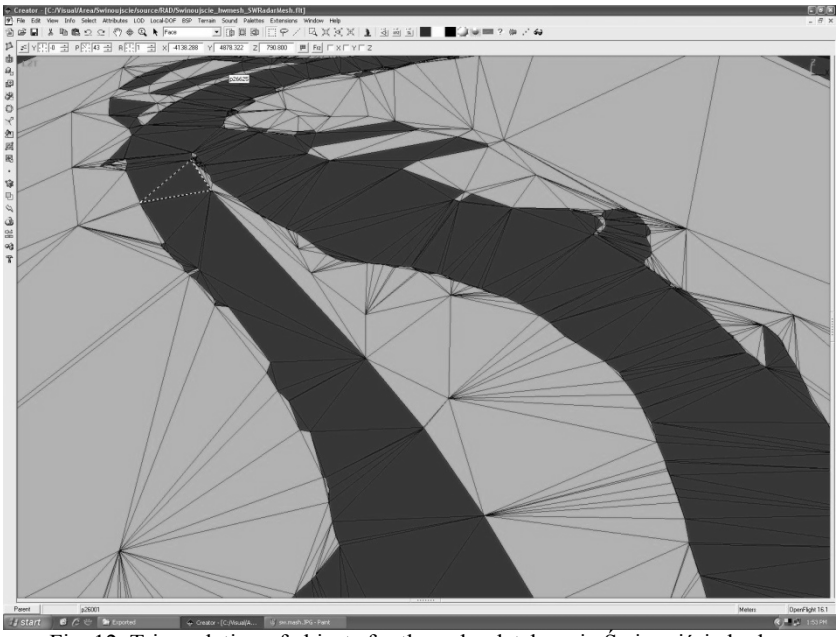

Fig. 12. Triangulation of objects for the radar database in Świnoujście harbor

Conclusion

Creation process of vessels' models and navigational basins is laborious and time-consuming. Moreover wide documentation like technical records, hydrodynamic characteristics, basins' plumbing, is required and very often difficult to collect or simply unavailable. Discretization and later data handling have to be executed on the high confidence level, so to provide with reliable reality reflection. 3D graphics programming requires the ability to work in Multigen Creator environment, which is highly specialized and not much popularized tool. The freedom of ship's model building and creating the navigation areas in 3D visualisation makes the simulator very flexible and autonomic. It can be widely used in safety of navigation assessment the traffic sea engineering is involved.

References

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3. Haring P., *SeaGen Manual - Plug-ins to MultiGen Creator,* Kongsberg Maritime Ship Systems AS, Horten, 2003, Norway
4. Zalewski P., *Sprawozdanie z realizacji zlecenia dla Escort,* Maritime Academy of Szczecin, Szczecin, 2007, Poland