Optimal exploitation of extraction areas

C-Star MaPos (marine positioning system) and C-Star Office Monitor
Extraction Monitoring
Visualisation of dredging in real time

The MaPoS_DGPS system – short for Marine Position Differential Global Positioning System – is an extraction control system developed by Dekker Dredgers for the efficient extraction of deposits and dredging areas. Our aim: optimal exploitation of extraction areas, the reduction of extraction losses, optimisation of extraction processes, and the minimisation of slope failure risks. Your benefits: precise positioning of the dredger and the excavation apparatus, direct visualisation of all information during the dredging process, and simultaneous documentation of all data using the same software.
The MaPoS system can be used with any kind of dredger and includes the following components:

- a robust industrial PC with the newest technology installed on board the dredger;
- a touchscreen monitor (no keyboard or mouse necessary for operation);
- dual GPS receiver with integrated digital compass;
- IPC electronics, sensors, and cabling; and
- dredger and office analysis software
The main characteristics of our dredge monitoring system are:

- The dredging can be done systematically within predefined limits according to the approval guidelines and in order to minimize losses of raw material. A further dredging of the already dredged areas will not be necessary afterwards. This results in considerable savings of personnel- and operational costs.

- Exceedance of dredging limits in the critical slope area will be avoided. Thereby the risk of slope failures is minimized.
Recordings of positions and depths of the dredging are possible and can be provided to approval authorities if necessary.

The height of the seabed in the dredging area is recorded continuously by deployment of echo sounders. The results are visualized on the monitor of the dredge monitoring system as plan and profiles. Slides within the dredged area and in the periphery can optionally be recorded.
C-Star MaPos_DREDGER offers versatile display options for dredger operators and remote monitoring:

Position and orientation determination of dredging tool by satellite-based measuring device (DGNSS/TRK) and sensors. Continuous visualization of information during the dredging process for the operator. Evaluation of the data with the same office and planning software.

- Freely movable 2D, 3D and profile views;
- Continuously updated remaining material maps and the success control of the dredging process;
- Adjustable grid size to adapt the dredging accuracy;
- Remote maintenance, service and training;
- Choice between dredging display and optional: echo sounder display;
- Field boundaries, mining boundaries, slope angles, mining horizons, tolerance ranges and operating standards;
- Print of plans and cross sections of the dredging area being true to scale;
- Specifications of mining areas for the dredging operator;
- Delimitation of non-minable areas or restricted zones;
- Estimation of the dredged quantities for output assessment;
- Determination of the productive dredging times;
- Comprehension of the dredging paths;
- Export of the data into CAD- or GIS-programmes;
- Real-time visualization of efficiency and productivity;
- Real-time visualization of consumed energy and costs;
- Morphology of the water bottom;
- Actual and target slopes;
- Exploitable material thickness at the current position of the dredger;
- Dredger obstacles, intermediate medium and other special features of the deposit;
- Current position of the loosening tool at an appropriate position accuracy;
- Success control of the intended areal removal by color-coded marking;
- The dredging control is realized by a continuous and direct information of the dredger operator during the dredging process;
- Combination of schematic display and satellite images (GeoTiff), superimposed or in adjustable transparency;
- Data logging for documentation;
- Analysis of the data is possible with the C-Star MaPos_OFFICE software;
- Visualization of slope landslides in the area of the dredger;
- Working method;
- Dredging performance;
- Display of the optimal cut in accordance to the spud position;
- Spud position/movement and depth/heights;
- Direct data transfer from dredger to operating management computer;

**Optional**

- Anchor position
- Pitch and roll of the dredger
- Slope sonar,
- Echo sounders, 360° sonar scanner, turbidity upgrade
- Automatically water-level adjustment
- Acquisition of system operational data (power consumption, mass flow rate, etc.)
- More than one dredger displayed on the screen
- Operation data Dashboard (visualization of energy consumption, dredging performance,
C-Star MaPos_DREDGER  
Software Version 9.x.

The software is used for the collection of data and the visualisation of the dredging process. On board the dredging operator is provided continuously with the following information in a 2D or 3D view of a plan display and also in a user-defined cross-section display:

- Real estate boundaries, mining boundaries, slope angles, quarrying horizons, tolerance ranges and operating standards;

- Morphology of the seabed;

- Target-and actual slopes;

- Remaining material thickness at the current dredging position;

- Dredging barriers, interburden, other features of the deposit;

- Current position of the loosing tool at reasonable accuracy of the position (accuracy within decimetre range);

- Visible success of the intended extensive removal displayed by colour-coded labelling of spatial areas, which are not sufficiently dredged.
Scope of MaPos_DGPS:

- Durable, up-to-date industry-PC on board of dredger;
- Touchscreen monitor;
  - Dual-GPS-receiver/RTK with integrated digital compass;
- IPC-electronics, sensors (e.g. echo sounders, depth sensor), required cables set;
- Dredger software, office software for data evaluation and planning of the dredging process

MaPos_OFFICE: features and applications:

- Display modes identical to MaPos_DREDGER
- Evaluation of activities (warping, working times day/month/year, ...)
- Direct comparison of mining data and optional echo sounder data e.g. as evidence for authorities
- Creation of profile sections, also as a group with freely selectable spacing
- Display of additional map content (e.g. plots, property boundaries, etc.)
- Volume estimation of removed material
- Dredge planning
GPS Dredging Monitoring System

Marine Positioning System - Real time Dredge monitoring
Operating Management System
MaPoS

Marine Positioning System
Do you know your primary dredging losses caused by slope failures?
Do you know your dredging losses caused by equipment?

C Star provides you with the answers!
Motivation

- optimization of the deposit yield, reduction of mining losses \(\Rightarrow\) increased profitability

- reduction of dredging area requirement and thus reduction of the ecological footprint

- documentation of the mining for internal process optimization and towards third parties (e.g. compliance with permits)

- improvement or guarantee of operational safety, e.g. by reducing the damage potential in the course of slope dredging

- basis for automation
visualization of a bucket chain dredger in operation
modular design for various applications
MaPoS has a modular design and can be easily adapted for any special requirements.

Whether on suction dredgers, grab dredgers or other special dredgers.
Features

• position & orientation determination of dredging tool by satellite based measuring device and sensors

• continuous visualization of information during the dredging process for the operator

• evaluation of the data with the same software (C Star in house development)
Display of

- morphology of the water bottom
- exploitable material thickness
- current position of the dredger
- field boundaries, mining boundaries, slope angles, mining horizons, tolerance ranges and operating standards
- dredger obstacles, intermediate medium and other special features of the deposit
- success control of the intended areal removal
visualization of a grab dredger in operation
visualization of a grab dredger excavation (superelevated display)
Control and monitoring

- ... the targeted areal ablation (e.g. “traffic light display”)
- ... slope landslides in the area of the dredger
- ... dredge planning (e.g. target slope vs. actual slope)
- ... working method (e.g. regular warping, layer by layer removal)
- ... dredging performance
Scope of MaPoS

- durable, up to date industry PC on board of dredger
- touchscreen monitor
- Dual GPS receiver with integrated digital compass
- IPC electronics, sensors (e.g. echo sounders, depth sensor), required cables set
- dredger software, office software for data evaluation
Scope of MaPoS

- slope sonar, 360° sonar scanner
- electronic water level gauge with GSM
- direct data transfer from dredger to operating management computer
- acquisition of system operational data (power consumption, mass flow rate, etc.)
- remote monitoring
Modular Design

Outdoor

Indoor

dredger cabin

central distributor

DGPS antenna

4G antenna

modern (remote maintenance)

PC

monitor (touchscreen)

input / output

power supply

230 V

230 V

Outdoor

depth sensor

echo sounders

high quality modules can be adapted for any special requirements
for example: installed modules on a suction dredger
Electronic water level gauge with GSM

- to keep the water level up to date
- water level is transmitted to dredger by radio or cable
Electronic water level gauge with GSM

- precision 2.4 cm x,y height 3.5 cm (Z)
- also position in the Z direction available with high accuracy
- automatic updating of the water level gauge
- fee based satellite correction services

RTK Real Time Kinematic
**Electronic water level gauge with GSM**

- The MaPoS Mobil system can be used to perform measurements in order to detect changes in dredged and non-dredged areas.

- The DGPS receiver provides position data and an echo sounder sensor the corresponding depth data. The data is continuously transmitted to the mining device via a radio link and displayed there. The digital terrain model is continuously updated.

- A major advantage is that no additional personnel is required to create a Digital Terrain Model. The system automatically creates a DGM.

- To create a background map information about the location of the lake, DXF/DWG files and a GeoTiff are required. If the DXF/DWG files and a GeoTiff are not available, these files can be created by SPE. The creation of the files will be charged according to effort.

**RTK Real Time Kinematic**
• Suction dredger standard: 5 echo sounders
• Grab dredger standard: 7 echo sounders

Current visualization of the excavation area and the slipped back material

Echo Sounder equipment
Echo sounders with turbidity option

- increased accuracy in turbid waters through direct signal processing for single echo sounders
- compensates the discharge of sediments by the treatment or by the dredging process
Multibeam (echo sounder)
Scans the bottom of the lake and provides a high resolution three dimensional terrain model

Multibeam for high resolution scans
Remote Access

remote maintenance access
visualization of operating status
and process chain optional

automated control system / DGPS
real time visualization of consumed energy and costs

Dashboard Example
real time visualization of efficiency and productivity

Dashboard Example
MaPoS
Marine Positioning System

software for real time visualization of the dredging process
MaPoS Dredger offers versatile display options for dredger operators and remote monitoring

- position and location of dredger and dredging device
- freely movable 2D, 3D and profile views
- different reference horizons such as original state, excavation limits, nominal slope and actual state
- continuously updated remaining material maps
- combination of schematic display and satellite images, superimposed or in adjustable transparency
- choice between mining display and echo sounder display
2D map in top view and profile cut (depth of the lake is color coded)
Full screen display. Fade in of a georeferenced satellite picture (GeoTiff) by reducing transparency level.
GeoTiff is almost opaque, showing the two operating cutting wheel dredgers in this quartz sand lake. The GeoTiff supports the dredger operator to get familiar with the MaPoS system.
At full opacity the mined material since recording is shown.
A better 3D impression with more shadows added. The level surface shows the good work of the operators. The size of the cut window is equal to the length of the green and blue line.
The 3D terrain map is changed to echo sounder view. This is the current real surface detected by several echo sounder sensors. The peaks are gone, the material has moved.
The section direction is changed and showing the stepped surface of the hard quartz material. The manual 3D mode allows any kind of bird’s eye view within the digital terrain map.
The dredger at another position in the lake. The terrain map is switched to the mode “Origin”. This is the initial state of the terrain, created by the survey data, without mining.
The current state of the lake after mining.
This map shows the remaining material: green = ok, light blue = high amount of remaining material, red = dredged over the limit MaPoS Dredger
The slope landslide can be perceived very easily with the switched on GeoTiff
The mined material is marked in orange, while the slope failure is shown as part of the initial Digital Terrain Model (DTM) contained in the bathymetrical survey data.
MaPoS
Office
software for analysis of the recorded mining data
MaPoS features and applications

• display modes identical to MaPoS Dredger

• evaluation of activities (warping, working times day/month/year, ...)

• direct comparison of mining data and echo sounder data
e.g. as evidence for authorities

• creation of profile sections, also as a group with freely selectable spacing

• display of additional map content (e.g. plots, property boundaries, etc.)

• volume estimation of removed material
Evaluation of working hours with the Office software MaPoS DGPS Office.

Creating the cut lines and preview on the profile section with MaPoS DGPS Office, as output basis line for a group of automatically generated profile cuts.
The MaPoS Office software has the same options for displaying information as the MaPoS Dredger software. Together with the DTM (with integrated boundaries) a GeoTiff picture and a 2D layer file (with additional terrain info) can be displayed.
The client can easily add/import a CAD dxf file with self created plots to plan the excavation work in detail.
Volume calculations can be done for the entire DTM or for generated boundaries (here for the plots). The tables show removed and remaining material referred to the target horizon.
A profile cut can be created and added to a list. The preview of the section below shows the target horizon (red), the initial water bottom (brown) and the mining (blue).
The generated profile sections can be plotted or saved as pdf files. The scaling is free selectable. Compression or stretching can be useful for better visualization.
Together with section profile printouts, these scale correct printout of the section positions are usually accepted as documents by authorities to proof the duly conducted works according to the permit.
The current dredging status and progress can also be evaluated in 3D view within the MaPoS Office software.
The mining can also be displayed in historical/chronological sequence. This example shows the dredging tool positions of one day, recorded with a 30 sec interval.
The same day in more detailed presentation only with a grid display. This allows to check the efficiency of the dredging process.
The work of a whole month. Dredging tool positions of days, months or years can be displayed.
The mining course with the mining data (red framed with white dots) of one month in grid view to monitor the dredging.

MaPoS Office

analysis of the dredging effort
grid icons are displayed for release tool depths (and echo depths) if data is available for both depth values, a combined symbol is displayed. Color code as above. This allows the back slided material to be visualized.

mining data & echo sounder data: visualization of the back slide material depth of dredging tool echo sounder and distance from the TARGET depth are color coded in the plan view according to the following scale:

- blue above TARGET depth, material available
- green: TARGET depth reached
- red: below TARGET depth, overdredging
additional imported plots with separate volume estimation
Volume calculation for mining / residual amount
Profile section, e.g. to compare the TARGET (red) and ACTUAL slope (blue)
CAD-based Dredger Model to establish the MaPoS System
input for the CAD dredger model: a dimensioned design drawing
result: an idealized CAD dredger model for the MaPoS Dredger software