



*This document serves as a guideline to operate Navatics underwater vehicle, MITO.*

## 1. Product Profile

### 2.1. Introduction

Navatics MITO is an underwater vehicle that can be used to explore depths. It uses four highly efficient thrusters to stabilize and manoeuvre itself underwater. It captures 4K videos and 12 megapixel photos, and is capable of carrying extra payload without deterioration in performance.

MITO boasts 4 knots (2 m/s) maximum speed. The battery, designed to be replaceable, runs for 2 hours when fully charged. The tether floatation comes with 4 hours runtime, equipped with solar panel to extend usage duration.

### 2.1. Features Highlights

Navatics MITO is designed to be small and stable. The size and battery capacity is designed to fit the airlines specification for carry-on luggage.

Camera: MITO shoots 4K video up to 30 frames per second, and 12 megapixel stills. The larger sensor size improves MITO's low light performance.

Controller: Navatics MITO is equipped with four thrusters that enables it to manoeuvre freely underwater. It is capable of tilting up and down to 45° angles while holding its depth, heading, and orientation. The controller is very simple, it is very easy to pick up.

Video Transmission: Navatics MITO is equipped with Sensethink's Senseplay video transmission system, allowing it to transmit 1080p HD video at 30 fps from 500 m away.

## 2. Underwater Vehicle: Navatics MITO

This section introduces steps to setup and calibrate MITO's array of sensors before using it.

### 3.1. Using Navatics MITO

#### 3.1.1 Starting Up Navatics MITO

Navatics MITO comes with a tether floatation and a Senseplay Race controller. It comes assembled with propellers. The instructions below is provided to start MITO.

- 1) To start MITO, first open the battery chamber at the bottom part of Navatics MITO. Connect the battery cable to the battery's waterproof connector, then push the battery into the chamber to lock it in place.
- 2) To turn it on, switch on the battery and close the chamber.
- 3) When started, MITO is going to check for the states of its sensor. In the process, it will turn on LED lights as an indicator, as well as changing the color of LED ring to indicate the process. Once all sensors are calibrated, the LED lights will turn off and the LED ring will turn white. If the process is stuck, find the Sensor Calibration instructions on section 3.2 on Sensor Calibration

#### 3.1.2 Starting Up Tether Roller

The tether roller is a floatation device that receives the data from Navatics MITO and transmit it to Senseplay Race remote controller. The steps to start a roller is a following:

- 1) Next, connect the tether from the tether floatation to the top connector of the robot and turn on the tether by pulling up the antennae
- 2) There are 2 LED indicators on the tether roller, power indicator and signal indicator. Blinking signal indicator shows that the tether roller is ready to transmit video and data to the remote controller.
- 3) When using the tether roller, it is strongly recommended to cover the Type-C charging port with the provided rubber cover attached to the charging port

#### 3.1.3 Starting Up Remote Controller (Senseplay Race)

The Senseplay Race remote controller is the transceiver device that allows Navatics smartphone app to receive video from Navatics MITO, and allows users to send control commands to Navatics MITO. To use Senseplay Race controller, users can follow the following step:

- 1) **If users have not bind the controller with Navatics account, please check section 4 for account registration and device binding**
- 2) IF the device binding is completed, users

can connect smartphone app to Senseplay Race controller via USB port on top of the controller. There are 2 ports in the controller, a Type-A USB port for connecting Senseplay Race to phone, and another Type-C USB port for charging.

- 3) First, turn on remote using the power button at the bottom of the Remote
- 4) In the middle of the remote there is a switch users need to select between Android app and iOS app, select the appropriate mode depending the smartphone type.
- 5) Once the users open the app, the remote will start searching for the latest device it is connected to, or users can select another device to connect to. Once connected, users can start streaming and controlling Navatics MITO

### 3.2. Sensor Calibration

When first receiving MITO, it is recommended for users to calibrate the gyroscope and compass. In addition, compass recalibration is recommended when diving in new place, to adjust to the magnetic condition of the dive site. The instructions below provides guidelines to calibrate the compass.

- 1) First, start MITO and the tether floatation, and connect the Senseplay Race to MITO. (Follow section 3.1 for more details).
- 2) Start the Navatics app in the smartphone.
- 3) Go to *Camera View* and click on parameters settings icon to open the dialog box. Go to the calibration page (Check section 3.4.2 for more details).
- 4) Place MITO on a flat ground, let it is still, and press calibrate gyroscope. MITO will be restarted and the LED light will flash. The calibration process runs for around 1 second each.
- 5) Finally, press calibrate compass. The calibration process is as following:
  - 1) Hold MITO with the bottom facing the ground. Rotate horizontally for 360 degrees.
  - 2) Once the calibration finished the LED will be turned off. Now MITO is ready to dive.

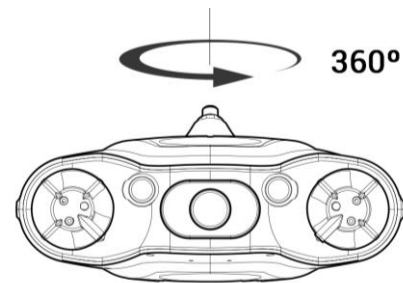


Figure 3.1 – Calibration Sequence: 360° horizontal rotation

### 3.3. Vehicle Motion Controller

Controlling MITO is very simple. Users are only required to move it in horizontal plane. The vertical plane and orientation control has been taken care of by the vehicle control system. There are a set of motion users can actuate with MITO, which are:

- 1) Dive → let MITO dive to depth by setting a target depth. It is capable of diving and rising while holding its attitude, subject to its thruster design
- 2) Tilt → MITO is capable of tilting and holding its attitude at a certain pitch angle. This, however, compensates the maximum horizontal speed it can actuate
- 3) Horizontal drive → MITO is capable of changing heading and move in the horizontal plane at any given pitch angle and depth

There list of automated motion is:

- 1) Set to flat → Set MITO back to flat orientation

### 3.4. Controlling Navatics MITO

#### 3.4.1 Basic Motion Control

Using Senseplay Surf controller to control MITO is really simple. The control scheme is described below.

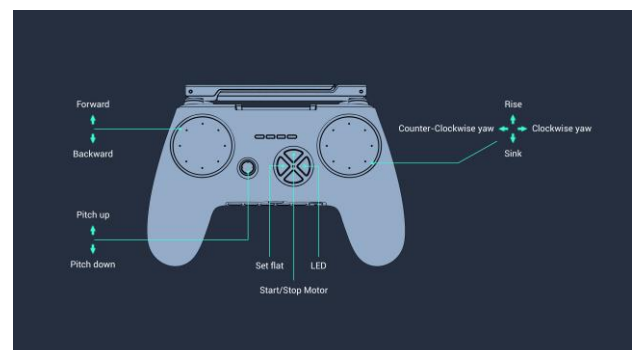


Figure 3.1 – Senseplay Race Control Scheme

### 3.4.2 Smartphone Application

The smartphone app is integral in operating MITO. It provides important information required to drive MITO, as well as vehicle settings. Users can also use the app to access the photos taken, then apply color correction filter to it.

Before entering the camera view, users would require to bind the Navatics MITO device and the remote to their account. To do so, follow the instructions in section 4: Account Registration and Device Bindings. Enter camera view by pressing “**Connect to MITO**” button. The camera view is shown below.

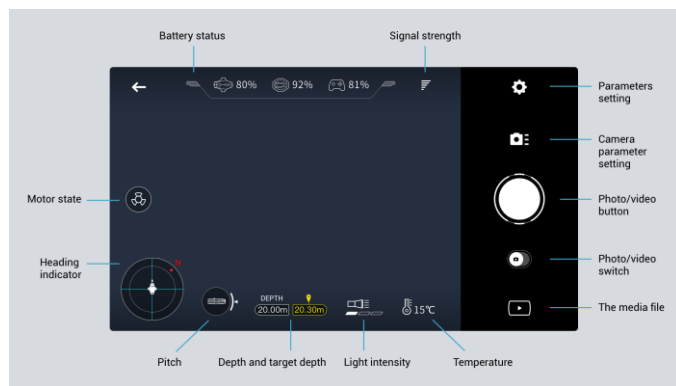
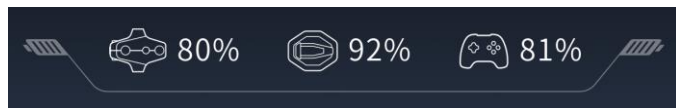


Figure 3.1 – App Camera View

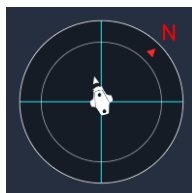
#### Battery Indicator

Battery indicator shows the battery of MITO, the tether floatation, and the remote



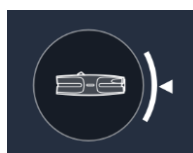
#### Heading Indicator

The heading indicator is relative to controllers orientation. The **Red North Arrow** shows where the North is relative to the users, and the **MITO icon** shows where it is heading.



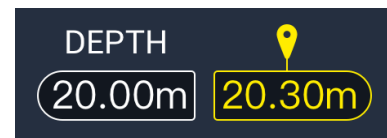
#### Pitch Indicator

The **MITO Icon** shows MITO's current pitch attitude



#### Depth Indicator

The depth indicator shows the controllable target depth (right), as well as the MITO's current depth (left)



#### LED Indicator

Shows the current LED level. Each bar represents a level of LED intensity.



#### Temperature Indicator

Shows the current temperature in MITO's surrounding



#### Motor State Indicator

Motor state indicator shows the current state of thrusters. When the thrusters are turned on, the propeller icon will start rotating. Clicking on the propeller icon will show average rotation speed of each thruster.



#### Parameters Settings

There are three parameters setting that can be changed. The first page controls MITO's limiter. There are 5 settings that can be changed, which are:

- Maximum Yaw Speed
- Maximum Forward/Backward Speed
- Maximum Dive/Rise Speed
- Maximum Depth
- Maximum Pitch Angle

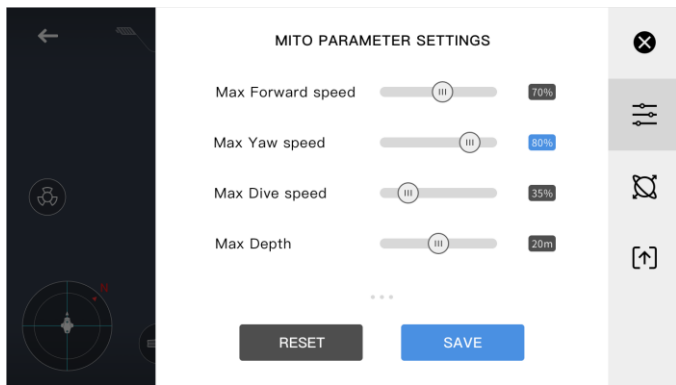


Figure 3.2 – Vehicle Limiter Settings

Once the values are set, click on **“Save”** to change the settings, or **“Reset”** to return it to the previous value.

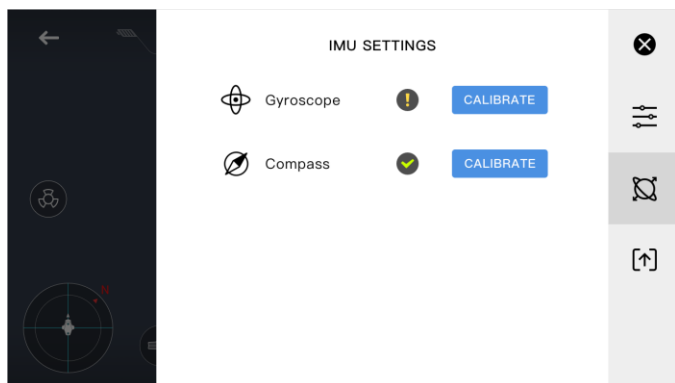


Figure 3.3 – Vehicle Sensor Status and Calibration Page

The second page is the calibration page. Each row contains status of the sensor, and a *Calibrate* button that would pop out a help page telling the users how to calibrate Navatics MITO. It is recommended to ensure gyroscope and compass status before diving to ensure best performance from MITO. In addition, it is beneficial to regularly recalibrate compass to prevent drift and magnetic interference, especially when diving in different spots.

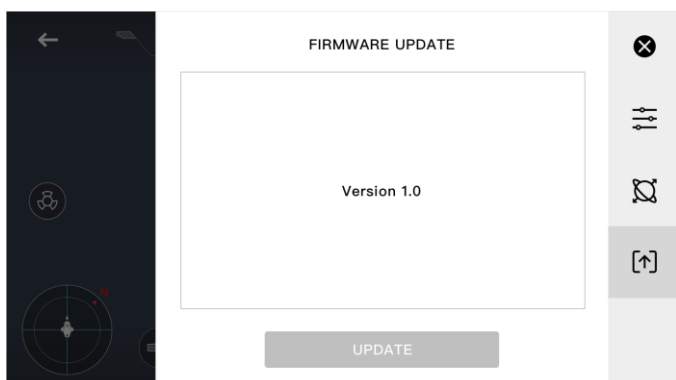


Figure 3.4 – Firmware Update Page

The third page is for MITO firmware update. Pushing the **“Update”** button will start an update sequence. It also shows the current firmware version.

### Camera Settings

Change various camera settings, such as the followings:



#### *1. Exposure Mode*

Users are able to configure the shooting mode, between auto-mode (*P-mode*) or manual mode (*M-mode*).



In *P-mode*, users can adjust:

**EV** Exposure Compensation Value (-2.0 to 2.0)

In *M-mode*, users can adjust:



Shutter speed (1/30 to 1/8000)



ISO (100 to 6400)

#### *2. White Balance*



In White Balance settings, users can select between *Auto*, *Manual*, *Cloudy*, *Sunny*, *Incandescent light*, and *Fluorescent light*.

### Camera/Recording Mode



Switch between photo mode and recording mode. In photo mode, users will be able to take 12M high resolution photos, and in the recording mode users can record high resolution videos. Difference in shooting page is shown in Figure 3.5 and Figure 3.6 The red button (Figure 3.5) and white button (Figure 3.6) are record and capture buttons respectively.

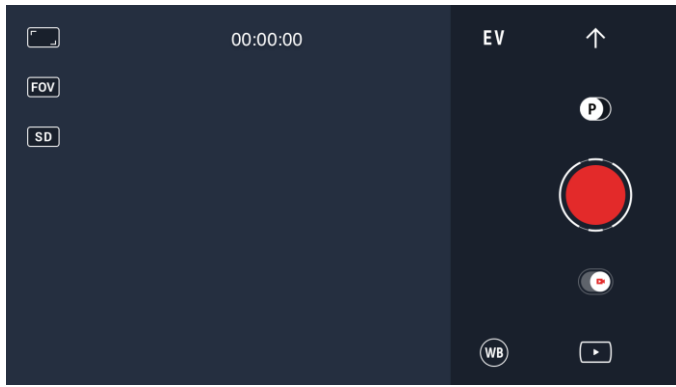


Figure 3.5 Recording View

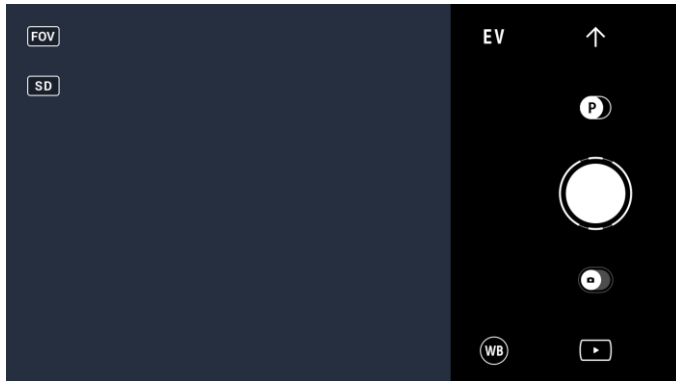


Figure 3.6 Photo Shooting View

#### FOV Settings



Allows users to choose between distorted, wider FOV mode or undistorted, narrower FOV mode.

#### SD Card Settings



Contains information about SD card storage (storage used, storage left, and SD card format)

#### Resolution Settings



**Only available in Video Recording Mode:** changes the recorded video resolution (1080p, 2K, and 4K)

### 3.5. Light Ring Indicator

On the top of MITO there is an LED indicator that changes its color depending on the current state of Navatics MITO. Currently, there are 3 listed colors that indicates Navatics MITO's state, which are:

1. **Red** indicates system failure, and action is needed, for instance: sensor failure or stuck thrusters

2. **Blue** indicates calibration phase, where users are expected to follow calibration steps (more on sensor calibration in section 3.2)
3. **White** indicates normal operating state of Navatics MITO

### 3.6. Viewing Pictures and Videos

Once users took some videos and pictures, they can view it in Navatics smartphone app.

#### Media Files

Users can click on “**Photo and Video**” buttons from the app's landing page, or from the bottom corner of the camera view screen to access captured images and video.

#### Color Correction Filter

When opening a picture, users can access Navatics' color correction filter function.

### 3.7. Viewing Dive Logs

Dive logs are taken everytime a user used MITO to dive. It will start recording the data when MITO dives deep enough, and stop recording the log when MITO is floating on the surface and the thrusters are turned off, or when it is running out of battery.

The dive log will record various data, including duration of dive, maximum depth, depth and temperature chart, maps, and display photos taken in the dive. The sample dive log is shown in Figure 3.7 and Figure 3.8

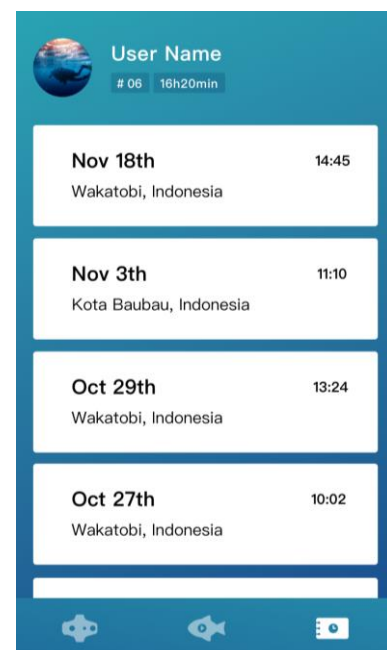


Figure 3.7 – Dive Log Selection Page

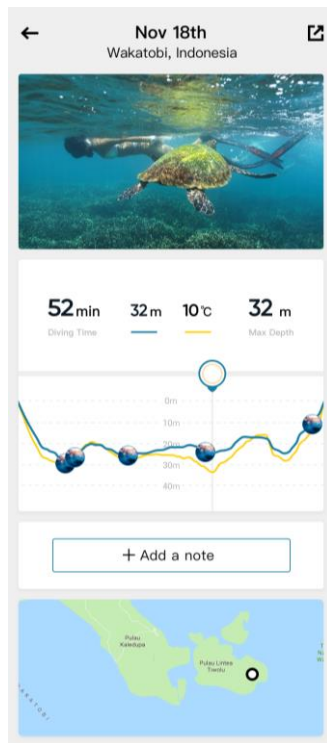


Figure 3.8 – Dive Log Display Page

### 3. Account Registration and Binding

In order to use Navatics MITO, users would be required to sign up a Navatics account with an email address. Once registered, users will be able to bind Senseplay Race remote and Navatics MITO device to an account.

After binded, the smartphone app will be automatically connect the binded Senseplay Race remote to the previous Navatics MITO the moment it establishes connection with the remote controller.

### 4. Power Management and Charging

#### 5.1. Navatics MITO Battery

##### Battery specifications

##### Indicator

Navatics MITO battery is equipped with 4 blue LEDs, each represents 25% of its total power.

##### Charger

(16.8V Charger).

When charging, the LED indicators will start blinking until the battery is full, then all LEDs will turn off.

#### 5.2 Tether Roller Power Management

##### Battery specifications

##### Charger and Charging Indicator:

Navatics MITO tether roller is charged using common USB charger via Type-C charging port. It supports both normal charging and fast charging. As an indicator, the power LED will start blinking when it is charging. In fast charging, the power LED in Navatics MITO tether roller will blink faster than in normal charging.

Navatics MITO tether roller is also equipped with solar charger, adding 1 hour usage in bright, sunny day.

Navatics MITO tether roller can be used while charging

### 5.3 Senseplay Race Controller

##### Battery specifications

##### Charger and Charging Indicator

Senseplay Race Controller is equipped with 4 battery indicator, each represents 25% of the battery power.

Senseplay Race Controller can be charged using common USB charger, it does not support fast charging. When charging, the power indicator will blink, and the blue LED among the buttons will light up.

Senseplay Race Controller can be used while charging.

### 5. Media Storage and Retrieval

When users captured images or record videos, there are 2 medias created, lower resolution cached storage in the phone, and full resolution storage inside Navatics MITO. To access the storage and retrieve the media files from Navatics MITO, the steps are as following:

- 1) Turn off Navatics MITO to free the storage usage from the camera before the following steps.
- 2) Connect the tether connector on top of Navatics MITO with connector-to-USB cable, to a PC
- 3) Once connected, the PC should detect a USB storage containing photos and videos from Navatics MITO

### 6. Maintenance

There are a few precautions that needs to be taken when using Navatics MITO. Please pay attention to

the following maintenance procedures:

- 1) After diving, especially in salt water, please rinse Navatics MITO with fresh water. This will help prevent salt cumulation and corrosion (especially in connectors)
- 2) Dry the connector, ensure that no water is in the connector pins before storing.
- 3) Ensure that the connector is tightly connected, and the O-Ring is present around the head of male connector. This will ensure the longevity of the connector pins. Failure to ensure and maintain the O-Ring condition may result in corrosion in connector's pins

## 7. FCC-ID Warning

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 1) Reorient or relocate the receiving antenna.
- 2) Increase the separation between the equipment and receiver.
- 3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

## 8. Changelog

|                                                                    |               |                          |
|--------------------------------------------------------------------|---------------|--------------------------|
| Version 1.0                                                        | Henry Liyanto | 8 <sup>th</sup> Feb 2018 |
| <ul style="list-style-type: none"><li>Initial submission</li></ul> |               |                          |

|                                                                                                           |               |                           |
|-----------------------------------------------------------------------------------------------------------|---------------|---------------------------|
| Version 1.1                                                                                               | Henry Liyanto | 22 <sup>nd</sup> Nov 2018 |
| <ul style="list-style-type: none"><li>Added New Features Manual</li><li>Added New Remote Manual</li></ul> |               |                           |

|                                                                                                                                                 |               |                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------|
| Version 1.2                                                                                                                                     | Henry Liyanto | 8 <sup>th</sup> Dec 2018 |
| <ul style="list-style-type: none"><li>Added dive logs images</li><li>Added LED indicator explanations</li><li>Fixed calibration steps</li></ul> |               |                          |

|                                                                                                                                                                                                                                                                 |               |                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------|
| Version 1.3                                                                                                                                                                                                                                                     | Henry Liyanto | 11 <sup>th</sup> Dec 2018 |
| <ul style="list-style-type: none"><li>Added charging section</li><li>Added media retrieval section</li><li>Updated camera settings section</li><li>Added starting up roller and remote section</li><li>Added account registration and binding section</li></ul> |               |                           |

|                                                                                                                                 |               |                           |
|---------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------|
| Version 1.4                                                                                                                     | Henry Liyanto | 11 <sup>th</sup> Dec 2018 |
| <ul style="list-style-type: none"><li>Added maintenance</li><li>Fixed typography</li><li>Added motor status indicator</li></ul> |               |                           |

|                                                                                                                           |            |                           |
|---------------------------------------------------------------------------------------------------------------------------|------------|---------------------------|
| Version 1.5                                                                                                               | Chang Zhao | 27 <sup>th</sup> Feb 2019 |
| <ul style="list-style-type: none"><li>Added FCC-ID Warning</li><li>Split into two columns</li><li>Format tuning</li></ul> |            |                           |