

roboception

Roboception GmbH | October 2024

rc_visard 3D Stereo Sensor

FIRMWARE CHANGELOG



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1 24.10.0 (2024-10-24)

1.1 New Features

- ItemPick (`rc_itempick`), BoxPick (`rc_boxpick`) and SilhouetteMatch (`rc_silhouettematch`): New sorting strategy to sort grasps and matches according to their distances from a user-defined point (see e.g. [SilhouetteMatch sorting strategies](#))
- GEV server (`rc_gev_server`):
 - Add RawCombined component and file interface for camera calibration via `rc_cube`
 - Add registers and chunk data with selfcalibration counter and offset

1.2 Improvements and Fixes

- Hand-Eye Calibration (`rc_hand_eye_calibration`):
 - Improved robustness of grid detection
- BoxPick+Match (`rc_boxpick`):
 - Fixed untextured rectangles not being returned when minimum coverage is given
- SilhouetteMatch (`rc_silhouettematch`):
 - Improved detection of objects when "Object Plane Detection" is used
- WebGUI:
 - Add button to download model or collision model ply from SilhouetteMatch template
 - Add option to filter database lists
 - Add option to toggle gripper element visibility
 - Rename R, P, Y to Rx, Rz, Rz and Roll/Pitch/Yaw to Rotation
 - Bring back logarithmic slider scaling for exposure times and min/max distances
 - Fixed SilhouetteMatch CAD objects not showing in 3D result visualization
 - Minor layout improvements and fixes

2 24.07.0 (2024-07-26)

2.1 New Features

- Manually configure additional NTP servers
- Measure node (`rc_measure`)
 - [New Measure node](#)
- BoxPick+Match (`rc_boxpick`)
 - Support detection of 3D boxes by setting z dimension of item model to detect rectangles corresponding to all sides of a box
 - Detection verification when 3D boxes are detected inside a load carrier
 - Visualization of 3D boxes in WebGUI
 - New [allow_untextured_detections parameter](#) to also return rectangles with matching dimensions but without matching view
 - Possibility to set user-defined names for views for easier reference
- SilhouetteMatch (`rc_silhouettematch`)
 - Add new [check_collisions parameter](#) and [check_collisions_during_retraction parameter](#)
- WebGUI:
 - Allow SilhouetteMatch base plane calibration in external pose frame
 - New interactive gripper creation by moving elements with the mouse
 - New System Time page for configuring synchronization including additional NTP servers
 - Option to duplicate and rename load carriers, grippers and regions of interest

2.2 Breaking Change

- Stereo Matching (`rc_stereomatching`)

- Moved service call `measure_depth` to new node `rc_measure`

2.3 Improvements and Fixes

- BoxPick (`rc_boxpick`)
 - Return only items corresponding to the returned grasps
 - Higher matching performance on small or weakly-textured boxes
 - Improved grasp ellipse computation for partly occluded textured rectangles
- gRPC Interface:
 - Fix subscribing only to left image
- WebGUI:
 - Add filter possibility to dropdown fields and support arrow and tab keys
 - Remove HDR warning for tag detections
 - Make "Exact Pose" the default when setting a pose for a load carrier
 - Fix cut-off point cloud in 3D result visualization
 - Show hint in camera calibration and warning bar when self calibration counter gets greater than 0
 - Support arrow keys to navigate through matches and grasps in 3d result visualizations (ItemPick, BoxPick, SilhouetteMatch)
 - Delay hover popups for grasps, matches and load carriers in 3D result visualizations
 - Bring back progress bar on template and CAD element upload
 - Add option to duplicate a gripper element or a grasp
 - Minor layout improvements and fixes

3 24.04.2 (2024-05-15)

3.1 Fixes

- SilhouetteMatch (`rc_silhouettematch`):
 - Fix collision checking with point cloud for grippers with rotated elements.
- WebGUI:
 - Minor fixes.

4 24.04.1 (2024-05-08)

4.1 Improvements and Fixes

- BoxPick+Match (`rc_boxpick`):
 - Fix crash in grasp computation in some corner cases when object is partly outside the image.
- WebGUI:
 - Minor fixes and improvements.
 - Disable `exposureAdaptTimeout` on `DepthImage` page when in Continuous mode.
 - Bring back progress bar on template and CAD element upload.

5 24.04.0 (2024-04-23)

5.1 New Features

- WebGUI:
 - New collision check visualization: Show contact point and provide collision category (in collision with LoadCarrier, Matches or PointCloud, etc.) in 3D visualisation for all `rc_reason` modules.

5.2 Improvements and Fixes

- TagDetect (rc_april_tag_detect, rc_qr_code_detect):
 - Allow setting size also when no ID or only family is given and allow size filtering also in these cases.
- LoadCarrier (rc_load_carrier):
 - Improve detection for some corner cases.
 - Add detection timeout of 25s
- BoxPick+Match (rc_boxpick):
 - Allow grasps only on unoccluded item surface.
- WebGUI:
 - SilhouetteMatch: Draw unchecked grasps in yellow color.
 - Gripper: keep global element and TCP pose when changing the parent

6 24.01.1 (2024-03-11)

6.1 Improvements and Fixes

- Ensure gRPC server can always start by adding port to reserved ports.
- Hand-Eye Calibration (rc_hand_eye_calibration):
 - Forcing detection of whole grid again as partial detection could result in degraded calibration in some corner cases. Instead exclude overexposed grid points from calculation.
 - Excluding grids if more than 16 calibration points (i.e. 4 squares) are over-exposed.
- EKI Bridge (rceki_bridge):
 - Log received and sent messages with info level so they show up in WebGUI log for ease of KRL program debugging.
- REST-API:
 - Prevent manually setting time to a date before firmware build time.
- WebGUI:
 - Minor improvements.

7 24.01.0 (2024-01-29)

7.1 New Features

- Stereo Matching (rc_stereomatching):
 - Add [measure_depth](#) service
- BoxPick (rc_boxpick):
 - Add new [PackedLayers](#) mode
 - Add new [min_cluster_coverage](#) parameter
 - New [BoxPick+Match](#) extension to (re)detect boxes according to their texture with consistent orientation. Requires a separate license.

7.2 Improvements and Fixes

- Stereo Matching (rc_stereomatching):
 - Added Gaussian smoothing of input images for stereo when matching is done in full resolution to enhance matching quality
- Camera Calibration (rc_stereocalib):
 - Prevent detection of grid if overexposed and show overexposure in visualization image and WebGUI
- Hand-Eye Calibration (rc_hand_eye_calibration):
 - Permit grid detection if up to 3 squares are missing
 - Visualize overexposed squares
- LoadCarrier (rc_load_carrier):

- Add detection timeout
- ItemPick (rc_itempick):
 - Rename “Surfaces” and “Grasps” visualizations to “Intermediate Result” and “Result”
- BoxPick (rc_boxpick):
 - Publish clustering result as intermediate result image in WebGUI
 - Rename “Grasps” visualization to “Result” visualization
- SilhouetteMatch (rc_silhouettematch):
 - Add right intermediate result image to display match edges from right image
 - Restrict replacing bright pixels with base plane to ROI
- REST-API:
 - reset_defaults service also resets preferred orientation and sorting strategies to default
 - Add Deprecation response header for api/v1 routes
- WebGUI:
 - Separate Try-Out section and result section for rc_reason modules
 - Add 3D visualization for LoadCarrier detection
 - 3D result visualizations: keep camera settings when switching to full screen and back
 - LoadCarrier and TagDetect now also show last detection result if triggered from robot
 - Scroll to selected element when opening dropdown
 - BoxPick+Match support with 3D visualization of matched views
 - Live update of symmetric grasp poses in SilhouetteMatch templates
 - Add shortcut buttons to apply grasp pose as replication origin in SilhouetteMatch templates

8 23.10.0 (2023-10-30)

8.1 New Features

- SilhouetteMatch (rc_silhouettematch):
 - Automatic [object plane detection](#). This feature is intended for the detection of planar stacked objects, e.g. metal sheets, without base-plane calibration.
 - Added optional [collision check with pointcloud](#).
- Add [gRPC image streaming interface](#): This interface that can be used as an alternative to the GigE Vision / GenICam interface for getting camera images and synchronized sets of images (e.g. left camera image and corresponding disparity image).

8.2 Improvements and Fixes

- Camera (rc_camera):
 - Much faster adaptation of auto exposure from overexposed images
- SilhouetteMatch (rc_silhouettematch):
 - Runtime improvements, on average 20% faster
- GEV server (rc_gev_server):
 - fix LatchTimestamp bit according to GigE Vision spec
- REST-API:
 - add [system/time](#) endpoint to manually set time (if not synced via NTP)
- WebGUI:
 - show network page even when system is not ready
 - show model name and user-defined name in top bar
 - update grid pose suggestions for hand-eye calibration
 - do not disable DNS server configuration when GigEVision app is running
 - improve point cloud rendering performance
 - always show template and CAD model in template modal if available
 - show time zone for all time stamps (detection results and logs)
 - show system time in UTC and local time
 - new modal for setting the system time
 - support SilhouetteMatch stacked objects and layout for SilhouetteMatch streams to three images

- fix symmetric grasps tooltip not shown when not symmetric

9 23.07.1 (2023-09-14)

9.1 Improvements and Fixes

- SilhouetteMatch (rc_silhouettematch):
 - Fix missed matches for tight ROIs
- WebGUI:
 - Move download all logs button and log level filter to top of log page

10 23.07.0 (2023-07-24)

10.1 New Features

- LoadCarrier (rc_load_carrier):
 - Added [detection of multiple load carriers](#) in detect_load_carriers and compute_filling_level services
- SilhouetteMatch (rc_silhouettematch):
 - Started pilot phase for SilhouetteMatch with automatic object plane detection. This feature is intended for the detection of planar stacked objects, e.g. metal sheets, without base-plane calibration and requires a separate license. Please reach out to info@roboception.de in case you are interested in participating in the pilot phase and obtaining the license.
 - Added creation of 3D collision model when [creating templates from DXF files](#)
- REST-API:
 - Support setting manual DNS servers

10.2 Improvements and Fixes

- LoadCarrier (rc_load_carrier):
 - draw three-sided rims for detected three-sided load carriers
 - add detected lines to the intermediate result image
 - fix error message when load carrier with exact pose is outside the image
- SilhouetteMatch (rc_silhouettematch):
 - add intermediate result image
 - change default matching parameters
 - fix DXF import in case undefined units are specified
- Hand-Eye Calibration (rc_hand_eye_calibration):
 - improve grid detection
- WebGUI:
 - improve filling level result in case of 0 coverage
 - fix layout for narrow pages, e.g. box headers, collision check status indicators
 - improve unsupported firmware/outdated license warning
 - Show warning when gripper TCP z axis is directed towards the flange
 - fix TCP frame not shown in gripper visualization when gripper is loaded
 - fix SilhouetteMatch base plane grid is not aligned with object origin
 - disable exposure radio buttons when GiGEVision application is running
 - fix error tooltip being shown in white balance radio buttons
- TagDetect (rc_april_tag_detect, rc_qr_code_detect):
 - fixed detection timeout
- GEV server (rc_gev_server):
 - fix xml: PrincipalPointV is also in middle of left image for IntensityCombined component

11 23.04.0 (2023-04-27)

11.1 Improvements and Fixes

- LoadCarrier (rc_load_carrier):
 - fix crash when load carrier with exact pose is outside the image, return error message instead
 - return measured load carrier dimensions for three-sided load carriers or load carrier detections without orientation prior or IMU
- WebGUI:
 - add shortcuts for template creation and LC/ROI/Gripper uploads in dropdowns
 - allow to choose units for SilhouetteMatch template creation from DXF
 - improve template upload bar hints by showing template/DXF verification step
 - show API parameter and node name in info box
 - disable dynamics settings and show warning when HDR is active
 - fix memory leak in useAccessControl, leading to increased memory and CPU usage on IOControl and Camera page
 - add warning for tag pose estimation and tag-based base-plane calibration in HDR mode
- REST-API:
 - swagger: add optional DXF units

12 23.01.1 (2023-02-22)

12.1 Improvements and Fixes

- Fix spurious timeouts when using HDR mode
- WebGUI:
 - show result of BoxPick detect_items call
 - fix no calibration shown for Yaskawa format

13 23.01.0 (2023-01-27)

13.1 New Features

- Added [High Dynamic Range \(HDR\) mode](#)
- Enhanced download of detection dumps for all reason modules:
 - TagDetect can also dump detections
 - include stereo input images with rc_randomdom pattern
- SilhouetteMatch (rc_silhouettematch):
 - added [uploading DXF files as template](#)
- WebGUI:
 - added access control to [lock Web GUI access](#)

13.2 Improvement and Fixes

- ItemPick (rc_itempick):
 - limit grasps to max_grasps after collision checking
 - fix grasp visualization in case of pruned grasps
- SilhouetteMatch (rc_silhouettematch):
 - do not show priority_filtered grasps in visualization
- LoadCarrier (rc_load_carrier):
 - added assume_gravity_aligned and min_plausibility params
 - improved 3d-lines based rim detection
- Rest-API:

- always nest return_code under response for service calls, also for invalid arguments or other early aborts
- WebGUI:
 - Show robot TCP in result visualization if provided
 - select external pose frame by default when hand-eye calibration is available
 - Always show external frame and grid in result visualizations when hand-eye calibration is available
 - add Yaskawa pose format
 - combine results of load carrier and filling level detection in one common table
 - optionally show priority-filtered grasps in match detection result visualization
 - minor Web GUI improvements and fixes

13.3 Changes

- rc_camera parameter `exp_auto` is deprecated and will be removed in a future release. The new `exp_control` parameter should be used instead.

14 22.10.0 (2022-10-25)

14.1 New Features

- LoadCarrier (rc_load_carrier):
 - add support for [three sided load carriers like pallet cages](#)
- SilhouetteMatch (rc_silhouettematch):
 - extended [grasp definitions with gripper_id, priority and replication](#)
 - add [only_highest_priority_grasps](#) parameter

14.2 Improvements and Fixes

- GripperDB (rc_gripper_db) and CollisionCheck (rc_collision_check):
 - only require gripper CAD elements to exist when using the gripper but not on loading/setting
 - allow flange as tcp parent id
 - check max size of all gripper elements < 1m
- WebGUI:
 - new combined pivot control to move grasps, ROIs, LCs and pose priors
 - visualize grasp replications
 - visualize gripper for grasp symmetries
 - visualize load carrier compartment in result visualization of ItemPick and BoxPick
 - show ROI in result visualizations
 - many small usability fixes
 - show missing grippers in template modal and missing CAD elements in gripper modal
- GigE Vision:
 - fix packet size negotiation with some producers:
 - * always write back valid/rounded packet size to SCPS according to GEV v2
 - * use stream channel source port also for test packets

14.3 Breaking Changes

- EKI Bridge (rceki_bridge):
 - [return -5 instead of -11 on REST errors](#)

15 22.07.0 (2022-07-22)

15.1 New Features

- TagDetect - AprilTag (rc_april_tag_detect):
 - add support for 41h12 family, removed support for 25h7 family.
- GripperDB (rc_gripper_db) and CollisionCheck (rc_collision_check):
 - add support for gripper CAD elements.
- Camera (rc_camera):
 - add gamma parameter.
- GigE Vision/GenICam:
 - add RcParamLockDisable, Gamma, ChunkGamma and ChunkLineMode features.
- WebGUI:
 - add 3D result visualizations to ItemPick and BoxPick
 - add option to display SilhouetteMatch 3D result visualization fullscreen
 - pose formats
 - * extend hand-eye calibration with more pose formats
 - * choose robot pose formats in Try-Outs and modals

15.2 Improvements and Fixes

- add processing_time status to all rc_reason modules
- change format of regions of interest and load carriers in dumps to enable upload via WebGUI
- add configured sorting strategies to last detection dumps
- TagDetect (rc_april_tag_detect and rc_qr_code_detect):
 - rename tag_detection_time status to processing_time
- REST-API:
 - if uploaded file is too large, also return return_code with message about max size
 - prevent setting IP to 127.0.0.0/8
- EKI Bridge (rceki_bridge):
 - if return_code.value indicates error, log with warning level so it's shown in WebGUI under EKI logs
- WebGUI:
 - camera: only hide out1_reduction in Normal
 - show accuracy of stored hand-eye calibration on status page
 - show processing_time for all reason modules
 - allow SilhouetteMatch 3D result visualization to be shown during loop mode
 - poll hand-eye calibration result on status page
 - fix bugs in gripper creation modal
 - deselect file in case there was an upload error for template and cad element upload
 - allow rotation around z for gripper element attaching
 - do not allow out-of-range values in number inputs in visualization menus
 - fix detect filling level button not showing loader while detection is running
 - adapt default names for new grasps and pose priors to be alphabetical
 - lots of fixes for 3D visualizations
 - show ROI visualization by default on LoadCarrier module page
 - fix reset of preferred orientation not applied at first click on a fresh page

15.3 Breaking Changes

- TagDetect - AprilTag (rc_april_tag_detect):
 - removed support for 25h7 family.

16 22.04.0 (2022-04-29)

16.1 Improvements and Fixes

- Stereo Matching (rc_stereomatching)

- when `double_shot` mode is used without the `ExposureAlternateActive` mode in `IOControl`, the same image is used to fill holes with disparity values from a lower resolution
- suppress artifacts in the disparity image near the left image border
- Hand-Eye Calibration (`rc_hand_eye_calibration`)
 - improve visual feedback by drawing fat green boundary if grid is fully detected and annotating even if it is only partially detected
- Camera Calibration (`rc_stereocalib`)
 - improve visual feedback if grid is fully detected in left and right image by drawing a fat green boundary
 - reset current error when grid is not recognized during verification
 - show the minimum and maximum error during verification
- ItemPick/BoxPick (`rc_itempick/rc_boxpick`):
 - runtime optimization for Full resolution `rc_visard` depth images
 - add timeout after 25s for BoxPick's `compute_grasps` and `detect_items` services
- SilhouetteMatch (`rc_silhouettematch`)
 - speed-up collision checking for continuous symmetric templates
- CollisionCheck (`rc_collision_check`)
 - add validation of pre-grasp offset
- AprilTag/QR Code (`rc_april_tag_detect/rc_qr_code_detect`)
 - return error when no hand-eye calibration available and external pose frame requested
- EKI bridge:
 - fix parsing of empty list elements and catch all exceptions
- WebGUI:
 - camera page shows the `IOControl` parameters for easier projector setup
 - separate download buttons for depth snapshots with and without point cloud mesh
 - add buttons to download/upload single LCs, ROIs, grippers
 - add validation of pre-grasp offset in Try-Out sections
 - improve robot pose fields in Try-Outs and 3D visualizations for robot-mounted cameras
 - SilhouetteMatch result visualization:
 - * improve visibility of grasps
 - * allow to hover and click grasps inside matches and matches inside load carriers
 - * add visualization of unreachable grasps that are filtered out due to the defined preferred TCP orientation
 - * add close button to notes for matches and grasps
 - add warning when collision checking is used without grasps in SilhouetteMatch
 - made axes in 3D visualizations wider
 - improve hand-eye calibration to update when new poses are added via RestAPI
 - disable reboot when system is not ready

16.2 Changes

- CollisionCheck (`rc_collision_check`)
 - The `collision_dist` parameter is applied only to load carriers and the SilhouetteMatch base plane instead of the gripper. Thus, this parameter is not used anymore for checking collisions between the gripper and other detected objects.

17 22.01.0 (2022-01-31)

17.1 New Features

- REST API:
 - introduce API v2, see [migration information](#)
- BoxPick (`rc_boxpick`):
 - add `mode` parameter for unconstrained or packed grid layouts of boxes
 - add `manual_line_sensitivity` and `line_sensitivity` parameters to configure line detector
- WebGUI:

- new layout with enhanced navigation side bar. This navigation side bar contains sub-menus to display the name of the current page and to make all pages reachable with one click. It also uses a responsive design with automatic collapsing on mobile devices
- reorganize System page in multiple pages: Firmware & License, Network Settings, GigEVision Status, Logs

17.2 Improvements and Fixes

- Hand-Eye calibration (`rc_hand_eye_calibration`):
 - wait until grid is detect in `set_pose` service (up to 1.5s)
 - add services `get_poses` and `delete_poses`
 - limit slot numbers to 0-15
- SilhouetteMatch (`rc_silhouettematch`):
 - sort matches as well according to selected sorting strategy
 - include request and response in detection dumps
 - add check for empty load carrier and that the object plane inside the detected load carrier
 - retain existing grasps on template update if the new template does not contain any grasps
 - increase matching timeout to 10 seconds
- LoadCarrier (`rc_load_carrier`):
 - include right image in detection dumps
- ItemPick (`rc_itempick`) and BoxPick (`rc_boxpick`):
 - include request, response and right image in detection dumps
 - draw load carrier rim in Surfaces and Grasps visualizations
- WebGUI:
 - allow creating and editing grippers with rotations and tree structure
 - new hand-eye calibration workflow showing stored poses and images
 - new annotations in camera calibration
 - added option to mirror images in camera calibration
 - automatic redirect when network settings have changed
 - higher resolutions of point cloud in 3D visualizations of ROIs, Load Carriers and SilhouetteMatch results
 - display resolution of current camera and depth image on the Camera and Depth Image pages
 - close fullscreen views by clicking anywhere or pressing ESC
 - make result tables automatically scroll to top when new results arrive
 - automatically update point cloud in SilhouetteMatch 3D result visualization when new result arrives
 - improved visibility of points inside a ROI or load carrier in 3D ROI or load carrier visualization
 - fixed SilhouetteMatch template aspect ratio for setting grasps
 - support setting of exposure regions or 2D ROIs by dragging rectangle in image on touch screens

17.3 Breaking Changes

- ItemPick (`rc_itempick`):
 - remove deprecated `item_model_tolerance` parameter
- The deprecated `load_carrier` services and parameters in the ItemPick, BoxPick, SilhouetteMatch and CADMatch nodes were removed. Please use the [services](#) and [parameters](#) provided by the `rc_load_carrier` module.
- EKI bridge:
 - The EKI bridge now reflects the API v2, please see the [migration notes](#)

18 21.10.0 (2021-10-26)

18.1 New Features

- StereoMatching (`rc_stereomatching`):

- add `exposure_adapt_timeout` parameter
- REST API:
 - parameters are now always saved automatically so `save_parameters` is not necessary anymore and hence deprecated
- GigE Vision/GenICam:
 - add `ChunkRcAutoExposureAdapting`
 - add `DepthExposureAdaptTimeout`

18.2 Improvements and Fixes

- Hand-Eye calibration (`rc_hand_eye_calibration`):
 - fix corner case when entering wrong poses for 4DOF
- SilhouetteMatch (`rc_silhouettematch`):
 - improve grasp selection for continuous symmetric templates
 - sort matches as well according to the selected sorter
 - accept templates with zero height
 - improve match duplicate filter
 - limit minimum value of `match_max_distance` to 0.1
- WebGUI:
 - show placeholder when system is not connected or not ready
 - improve general warning and error messages
 - removed "save parameters" buttons from module pages as they are auto-saved now
 - improved marquee selection for 2D ROI and exposure region and added button to reset exposure region
 - improved template modal
 - * add tab with more details of the template
 - * show gripper in grasp visualization
 - * made grasp list more compact
 - add hint in preferred orientation visualization when z axis points towards the camera

18.3 Other Changes

- REST API:
 - Renaming of `rc_stereocamera` to `rc_camera`. For backwards compatibility the now deprecated name `rc_stereocamera` will redirect to `rc_camera`.

18.4 Deprecations

- The `load_carrier` services and parameters in the `ItemPick`, `BoxPick` and `SilhouetteMatch` nodes are deprecated and **will be removed in January 2022 with version 22.01**. Please use the [services](#) and [parameters](#) provided by the `rc_load_carrier` module.
- The `item_model_tolerance` parameter in the `ItemPick` node is deprecated and **will be removed in January 2022 with version 22.01**.
- The node name `rc_stereocamera` is deprecated and will be removed in a future version. Please use `rc_camera`.
- The `save_parameters` service call is deprecated and will be removed in a future version.

19 21.07.0 (2021-07-21)

19.1 New Components

- OPC UA Server: New module that allows communicating with the `rc_visard` and the `rc_visard` via the [OPC UA](#) communication protocol.

The OPC UA Server is available as an Early Access preview feature. Please contact us if you would be interested in testing the OPC UA interface.

19.2 New Features

- add grasp sorting strategy selection to [ItemPick](#), [BoxPick](#) and [SilhouetteMatch](#)
- include grasps when downloading [SilhouetteMatch](#) templates
- LoadCarrier ([rc_load_carrier](#)):
 - add detection of gitter boxes/pallet cages by extending load carrier definition. This is available as an Early Access preview feature. Please contact us if you would be interested in testing this feature.
 - add [pose_type](#) to load carrier model to support [Exact Poses and Orientation Priors](#)
- WebGUI:
 - add 3D result visualization to [SilhouetteMatch](#)
 - add interactive Menus to all 3D visualizations with Controls and View Options

19.3 Improvements and Fixes

- persist parameters across [firmware updates](#)
- improve system ready notification at boot
- LoadCarrier ([rc_load_carrier](#)):
 - add snapshot dumps for last detection
- SilhouetteMatch ([rc_silhouettematch](#)):
 - fix bug that caused less object to be detected in some scenes
 - extend data included in snapshot dumps for last detection
- BoxPick ([rc_boxpick](#)):
 - improve detection with small dimension ranges
- ItemPick ([rc_itempick](#)):
 - fix segmentation for small clusters far away from camera
- WebGUI:
 - allow download of templates in [SilhouetteMatch](#)
 - new 3D orbiting control for unconstrained rotations
 - only show min distance warning if depth range is actually reduced
 - show hint if new [rc_randomdot](#) projector is connected
 - allow editing and deleting elements in Try-Out dropdowns
 - show if system requires a reboot when dongle is reconnected
- GEV server:
 - add [ChunkLineStatus](#)

19.4 Other Changes

- Grasps and load carriers are internally migrated to new storage format and not available any more if a rollback to a previous firmware version is performed. It is advised to create a [backup](#) before upgrading if a rollback might be desired.
- REST API:
 - node status: rename [stale](#) to [idle](#) and add [initializing](#)
- IOControl [get_io_values](#) service changed to support varying number of IOs

19.5 Deprecations

- The [load_carrier](#) services and parameters in the [ItemPick](#), [BoxPick](#) and [SilhouetteMatch](#) nodes are deprecated and will be removed in a future version. Please use the [services](#) and [parameters](#) provided by the [rc_load_carrier](#) module.

20 21.04.1 (2021-04-20)

20.1 Fixes

- network settings: fix check if IP is already in use when no route to given IP is available

- WebGUI:
 - fixed rotation of grid for SilhouetteMatch template visualization
 - only show full screen icons for depth images in continuous acquisition mode

21 21.04.0 (2021-04-15)

21.1 New Components

- **LoadCarrier** (`rc_load_carrier`): New module that allows setting and retrieving load carriers, as well as detecting load carriers and their filling levels.

The LoadCarrier module is an optional on-board module of the `rc_visard` and is licensed with any of the modules ItemPick, BoxPick, or SilhouetteMatch. Otherwise it requires a separate LoadCarrier license to be purchased.

21.2 New Features

- SilhouetteMatch (`rc_silhouettematch`):
 - add `check_collisions_with_matches` and `check_collisions_with_base_plane` parameters
- REST API:
 - add `backup/restore functionality` to download and upload the complete configuration of an `rc_visard`
- WebGUI:
 - organize modules into detection modules and configuration modules
 - add import/export of grasps for SilhouetteMatch templates
 - new LoadCarrier detection module
 - new Regions of Interest page for configuring regions of interest for all detection modules
 - add optional item maximum dimensions to ItemPick Try-Out section
 - add fullscreen control to images in stream view

21.3 Improvements and Fixes

- LoadCarrier (`rc_load_carrier`)
 - return estimated dimensions of detected load carriers
 - improve load carrier detection in low contrast scenes
- SilhouetteMatch (`rc_silhouettematch`):
 - grasp sorting combines orientation and distance to preferred orientation
 - allow collision check with all detectable objects
 - disambiguate equally good grasps for symmetric templates
 - enforce detection timeout of 5 seconds
- ItemPick (`rc_itempick`) and BoxPick (`rc_boxpick`):
 - improve detection of small rectangles at large camera distances
 - added compartment to load carrier visualization
- REST API:
 - return `object_uuid` for SilhouetteMatch templates
- WebGUI:
 - allow up to 8 poses during Hand-Eye Calibration
 - moved Try-Out sections below image streams in all detection modules
 - add shortcuts to create Load Carriers, Regions of Interest and Grippers from the Try-Out section of all detection modules
 - show positions with four digit precision in detection result tables
 - show SilhouetteMatch 3D collision model when configuring grasps
 - show default values for all parameters in info boxes
 - ask if firmware update should be applied if filename indicates wrong image
 - show message if websocket connection is not available
 - also use port 80 for websocket

- enforce max length of 60 characters for all IDs
- show logs for EKI bridge
- show why network setting could not be applied

22 21.01.0 (2021-01-29)

22.1 New Features

- BoxPick (rc_boxpick):
 - add prefer_splits parameter
- SilhouetteMatch (rc_silhouettematch):
 - collision check with other detected objects
- REST API:
 - UJSON support, via application/ubjson mime type in Content-Type and/or Accept headers
- WebGUI:
 - Download last detection of ItemPick, BoxPick, SilhouetteMatch as tarball with visualization images

22.2 Improvements and Fixes

- ItemPick (rc_itempick):
 - improve segmentation of objects with dimensions and few 3D edges
- BoxPick (rc_boxpick):
 - improve box detection using confidence image for 2D edges as well
- Hand-Eye calibration (rc_hand_eye_calibration):
 - minimize geometric loop closure error instead of reprojection error and return more error values
- WebGUI:
 - downloadable JSON response of try-outs now matches full REST-API response
 - visualization image selection via dropdown

22.3 Other Changes

- REST-API:
 - return image version without device and 'v' prefix

23 20.11.0 (2020-11-23)

23.1 New Features

- SilhouetteMatch (rc_silhouettematch):
 - Add collision detection with base plane
- StereoMatching (rc_stereomatching):
 - New double_shot mode: Combine images from two subsequent stereo image pairs. This is meant for the use with a random-dot projector in ExposureAlternateActive or SingleFrameOut1 acquisition mode.
- Camera (rc_stereocamera):
 - New Out1High auto exposure mode: Adapt exposure time using only images with GPIO Out1 high. This is meant for the use with a random-dot projector in SingleFrameOut1 acquisition mode.
- WebGUI:
 - Japanese translation
 - Add snapshot download on depth image page (with disparity and pointcloud as ply)
 - Optionally show image that is actually used by stereo matching on depth image page

- Download try-out requests as JSON

23.2 Improvements and Fixes

- BoxPick (rc_boxpick):
 - Fix missing detections in packed scenes
 - Also draw detected box in grasp visualization
- SilhouetteMatch (rc_silhouettematch):
 - Improve refinement
- Hand-Eye calibration (rc_hand_eye_calibration):
 - Service get_calibration strictly returns only saved result. Before it returned values of calibrate call, even if save_calibration was not called
 - Service set_calibration implicitly calls save_calibration
 - Extended collinearity check to ensure that positions are at least 3 mm apart from each other

23.3 Other Changes

- GigE Vision/GenICam:
 - add DepthDoubleShot feature
 - add Out1High to ExposureAuto enum
 - rename RcAdaptiveOut1Reduction to RcOut1Reduction

24 20.10.0 (2020-10-13)

24.1 New Features

- WebGUI:
 - 3D ROI visualization
 - simplified specification of grid size for calibration
- SilhouetteMatch (rc_silhouettematch):
 - added load carrier detection
 - added grasp point specification
 - integrated CollisionCheck module
- StereoMatching (rc_stereomatching):
 - smooth disparity interpolation
 - disparity border smoothing
- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - common loadcarrier and ROI dbs
- GigE Vision/GenICam:
 - add support for GevSCSP (stream channel source port) with fixed port 50010

24.2 Fixes

- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - updated grasp quality computation by taking distance into account

24.3 Other Changes

- Camera (rc_stereocamera):
 - set default for maximum exposure time to 18 ms
 - add parameters exp_auto_average_min and exp_auto_average_max for fine tuning of auto exposure
- StereoMatching (rc_stereomatching):
 - remove parameter disprange
 - remove parameter median

- IOControl (rc_iocontrol):
 - Set default of out1_mode to low
- GigE Vision/GenICam:
 - removed DepthMedian, DepthDispRange
 - add RcExposureAutoAverageMax and RcExposureAutoAverageMin
 - add DeviceLinkSpeed
 - minor updates and generic SFNC features

25 20.04.1 (2020-05-07)

25.1 Fixes

- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - fix ROI pose if external frame is used
 - fix rejection un-normalized input quaternions
 - set timestamp in response even if request is invalid
- TagDetect (rc_april_tag_detect and rc_qr_code_detect):
 - set timestamp in response even if request is invalid
 - always use full name for quality parameter (High, Medium, Low)
- SilhouetteMatch (rc_silhouettematch):
 - always use full name for quality parameter (High, Medium, Low)
 - detect service: return -1 (invalid argument) if ROI offset is larger than image
- Hand-Eye calibration (rc_hand_eye_calibration):
 - re-compute calibration on calibrate service call if robot_mounted parameter changed
- REST API and Web GUI:
 - correctly report MAC and link speed even if no default gateway is set
 - show 'AdaptiveOut1 Reduction' value on camera page if this exposure mode is chosen
 - fix issues with floating image streams on Chrome

26 20.04.0 (2020-04-17)

26.1 New Features

- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - integrate new CollisionCheck module
 - add [load carrier filling level detection](#)
 - add load carrier overfilled flag
- SilhouetteMatch (rc_silhouette):
 - support [calibration to closest base plane](#) via new plane_preference parameter
- TagDetect (rc_april_tag_detect and rc_qr_code_detect):
 - add support for [external pose frame](#)
- Hand-Eye calibration (rc_hand_eye_calibration):
 - support calibration for robots with constrained motion, e.g. 4 DOF
 - add [set_calibration service](#) to re-upload calibration previously retrieved via get_calibration
- Camera:
 - add new [auto exposure mode AdaptiveOut1](#) that optimizes exposure for use with a projector
- Web GUI:
 - add [network configuration](#)
 - add download snapshot button on camera page
 - Try-out results can be downloaded as JSON file
 - show if device is not yet ready
- REST API:
 - add endpoints to change [network configuration](#)

26.2 Improvements and Fixes

- Stereo Matching (rc_stereomatching):
 - improvement of sub-pixel interpolation which reduces disparity steps
- Camera:
 - fixed auto-exposure flicker in full sunlight
- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - improve segmentation and box detection
 - increase maximum number of ROIs and load carriers to 50
 - increase maximum allowed load carrier dimensions to 2m

26.3 Other Changes

- rc_dynamics:
 - add return_code to get_cam2imu_transform service
- REST API:
 - improve error messages for invalid requests
 - new return_code values for adding elements, e.g. ROIs or load carriers:
 - * 10: element was added but max capacity is now reached
 - * -10: new element could not be added because the capacity was exceeded

26.4 New Components

- CollisionCheck (rc_collision_check): This module provides an easy way to check if a gripper is in collision with a load carrier. It is integrated with the ItemPick and BoxPick modules, but can be used as standalone product. This feature is currently only available as part of the 3D-R Vision & Handling Set from our partner J. Schmalz GmbH.
 - documentation: <https://doc.rc-visard.com/latest/en/collisioncheck.html>
 - access via REST-API and EKI interface
 - configurable via Web GUI

27 1.8.4 (2020-01-24)

27.1 Fixes

- EKI bridge: on error return more useful return_code from corresponding module
- rc_stereomatching:
 - Reset image buffer for static mode on trigger or switching to single shot
- rc_stereocamera:
 - Fixed reporting 0 baseline in diagnostic messages

28 1.8.3 (2019-12-02)

28.1 Fixes

- SilhouetteMatch (rc_silhouettematch): increase data acquisition timeout to 5s
- rc_stereomatching: make acquisition_trigger service available again
- REST-API:
 - improve serialization error messages
 - return http code 400 if service call failed with invalid argument

29 1.8.2 (2019-11-19)

29.1 Fixes

- fix model name for color sensors

30 1.8.1 (2019-11-18)

30.1 Fixes

- EKI bridge: fix handling of empty lists
- SilhouetteMatch (rc_silhouettematch): performance improvements
- rc_stereocamera:
 - Fixed error when choosing very small exposure region
 - Only apply new signal masks for GPIO outputs if they differ from the previous ones, so that the alternate pattern is not interrupted
- Web GUI: fix flipped grid visualization thumbnails on hand-eye-calibration page

31 1.8.0 (2019-10-07)

31.1 New Components

- SilhouetteMatch (rc_silhouettematch): This module detects position and orientation of comparatively flat objects that are positioned on a plane, by matching the scene at hand to a previously taught template.
 - documentation: <https://doc.rc-visard.com/latest/en/silhouettematch.html>
 - shop: <https://roboception.com/product/silhouettematch/>
 - access via REST-API
 - configurable via Web GUI
- EKI bridge: The Ethernet KRL Interface (EKI Bridge) allows communicating with the rc_visard from KUKA KRL via KUKA.EthernetKRL XML.
 - Use rc_reason onboard software with KUKA robots without any external PC
 - documentation: <https://doc.rc-visard.com/latest/en/eki.html>
 - shop: <https://roboception.com/product/ekibridge/>

31.2 New Features

- Web GUI:
 - Hand-eye calibration: allow redoing poses
- rc_stereomatching:
 - Add new acquisition mode SingleFrameOut1. This mode can be used to control an external projector. It sets the line source of Out1 to ExposureAlternateActive upon each trigger and resets it to Low as soon as the images for stereo matching are grabbed. (Requires IOControl license)

31.3 Fixes

- ItemPick (rc_itempick):
 - bugfix for grasp computation on surfaces with holes
- GigE Vision/GenlCam:
 - fix max PayloadSize

31.4 Other Changes

- REST-API:
 - save_parameters and reset_defaults return return_code instead of just message string

32 1.7.0 (2019-07-22)

32.1 New Features

- GigE Vision/GenICam:
 - add ChunkComponentIDValue according to SFNC 2.5
 - add ChunkDecimationHorizontal ChunkDecimationVertical
 - add ChunkLineSource and ChunkLineSelector
- ItemPick (rc_itempick):
 - sorting of grasps using gravity and size
 - accept lc and roi in camera pose_frame even if request is for external
 - compute grasp quality from surface rmse
 - performance improvements

32.2 Fixes

- fix log rotation for nginx to prevent disk running full
- GigE Vision/GenICam:
 - fix Decimation and Width for depth images in Low res
 - also apply AcquisitionAlternateFilter for SynchronizedComponents except if it would result in no images being sent
- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - various small fixes/improvements

32.3 Other Changes

- rc_dynamics:
 - added state-machine state "STOPPING"
- REST-API:
 - possibility to add/delete multiple datastream destinations at once
- ItemPick (rc_itempick) and BoxPick (rc_boxpick):
 - made pose_frame argument always required

33 1.6.1 (2019-04-01)

33.1 Fixes

- Web GUI:
 - fix for new BoxPick page

34 1.6.0 (2019-03-28)

34.1 New Components

- BoxPick (rc_boxpick): The optional on-board component of the rc_visard, which provides a perception solution for robotic pick-and-place applications such as de-/palletizing and sorting of packets. It allows the detection of stationary items with rectangular surfaces and the determination of their position, orientation and size for picking.
 - documentation: <https://doc.rc-visard.com/latest/en/boxpick.html>
 - shop: <https://roboception.com/product/boxpick/>
 - access via REST-API
 - configurable via Web GUI

34.2 New Features

- Web GUI:
 - depth image: add single frame acquisition mode
 - page for new BoxPick component
- GigE Vision/GenICam:
 - add DecimationHorizontal and DecimationVertical as readonly features
 - report if system is ready (fully booted) via custom RcSystemReady feature

34.3 Fixes

- Web GUI:
 - Improve translation of labels and info boxes
 - Various fixes in region of interest modal
 - Fix race condition in hand-eye-calibration
- ItemPick (rc_itempick):
 - scale all pixel parameters with resolution
 - various fixes/improvements for corner cases

34.4 Other Changes

- Web GUI:
 - Add acquisition mode parameter to depth image page
 - ItemPick, BoxPick, TagDetect, QRDetect: Request new detection only, if last response has arrived.
 - Hand-Eye-Calibration replace error modal popup with error message under each pose
- REST-API:
 - warn if service request contains unused args
 - itempick RegionOfInterest: only return actually used type (box or sphere)
 - also lock service calls of rc_stereocamera, rc_stereomatching and rc_iocontrol if a GEV application is connected
- StereoPlus (rc_stereomatching):
 - enable smoothing by default
- ItemPick (rc_itempick):
 - deprecate item_model_tolerance parameter (now read-only)
- TagDetect (rc_april_tag_detect):
 - performance improvements
- SLAM (rc_slam):
 - improve map loading and resets/restarts

35 1.5.0 (2019-01-31)

35.1 New Features

- New Module: StereoPlus (rc_stereomatching):
 - disparity image smoothing (enabled via smooth parameter)
 - full resolution disparity image
- Web GUI:
 - add exposure region selection via mouse
 - floating video streams
 - new parameters for StereoPlus (full resolution and smoothing)
 - allow deletion of hand-eye-calibration
 - hand-eye-calibration page shows current sensor mounting

35.2 Fixes

- Web GUI:
 - several layout/UI improvements and fixes
 - Hide white balance settings on calibration page
 - ItemPick update streams shown only after detection
 - fix kuka pose format calculations
- rc_hand_eye_calibration:
 - If calibration error is NaN or Inf, return failure with status code 2 and a message
 - fix concurrency bug
- ItemPick (rc_itempick):
 - surface segmentation: fix return code when roi is empty
- GigE Vision/GenICam:
 - return correct baseline and focal_length_factor even before fully booted up
- IOControl
 - fix GPIO output when switching from active to low

35.3 Other Changes

- add baseline and color/monochrome version to model name, e.g. "rc_visard 160m"
- GigE Vision/GenICam:
 - add GenICam parameters for StereoPlus:
 - * add DepthSmooth (requires stereo_plus license)
 - * add Full quality (requires stereo_plus license)
 - * remove StaticHigh quality
 - * add DepthStaticScene parameter (replacing StaticHigh, but also works in Full)
 - remove GevTimestampControlReset
 - add and fix TimestampLatch and TimestampLatchValue (GEV counterparts are deprecated)
 - add DeviceFirmwareVersion (same as DeviceVersion for now)
 - add sent_frames, dropped_frames and packet_resends in REST-API status values
- SLAM (rc_slam):
 - add return_code in get_trajectory response
 - add number of map_frames in status values

36 1.4.0 (2018-10-19)

36.1 New Components

- ItemPick (rc_itempick): The optionally available software component provides an out-of-the-box and model-free perception solution for robotic pick-and-place applications with suction grippers.
 - documentation: <https://doc.rc-visard.com/latest/en/itempick.html>
 - access via REST-API
 - configurable via Web GUI

36.2 New Features

- Web GUI redesign:
 - additional modules pages:
 - * ItemPick
 - * AprilTag and QRCode Detect
 - * IOControl
 - camera page:
 - * set gain manually
 - * set white balance manually for color cameras
- GigE Vision/GenICam:
 - support for GigE Vision 2.1 MultiPart

- add DepthAcquisitionMode and DepthAcquisitionTrigger
- add SFNC 2.4 category PtpControl with
 - * PtpEnable
 - * PtpDataSetLatch
 - * PtpStatus
 - * PtpOffsetFromMaster
- add AcquisitionMultiPartMode enum with
 - * SingleComponent: Immediately send one single component per frame/buffer when it becomes available.
 - * SynchronizedComponents: Only send a multipart frame/buffer iff all enabled components are available for that time.
- Improved auto exposure for reducing overexposure

36.3 Fixes

- REST-API:
 - return 400 error if parameter is out of min/max range
 - update Swagger UI to get correct cURL examples for Windows

36.4 Other Changes

- Web GUI:
 - removed French and Chinese translations

37 1.3.1 (2018-08-28)

37.1 Fixes

- REST-API:
 - fix error messages on service call failures (when some messages fields are of wrong type)
- GigE Vision/GenICam:
 - only reset block id when a new stream channel is opened
 - reduce latency on changing enabled components
- Web-GUI:
 - make doc links work in proxied environment

38 1.3.0 (2018-07-25)

38.1 New Components

- IO and projector control (rc_iocontrol): The optionally available software component allows read and write access to the rc_visard's GPIOs, e.g. to synchronize with external pattern projectors.
 - documentation: <https://doc.rc-visard.com/latest/en/iocontrol.html>
 - access via REST-API
 - access via GigE Vision/GenICam interface:
 - * category: DigitalIOControl, features: LineStatus, LineSource, etc.
 - * custom AcquisitionAlternateFilter which makes it possible to receive only images with/without projector(gpio) on

38.2 New Features

- TagDetect (rc_april_tag_detect and rc_qr_code_detect):
 - add detect_inverted_tags parameter that allows detection of negative, i.e. black/white inverted QRcodes and AprilTags in front of black background.

- possibility to specify approximate tag size to resolve ambiguous stereo tag matching
- GigE Vision/GenICam:
 - add support for setting exposure region:
 - * ExposureRegionWidth, ExposureRegionHeight, ExposureRegionOffsetX, ExposureRegionOffsetY
 - support extended chunk mode
 - new SFNC 2.4 features:
 - * Scan3dFocalLegth, Scan3dBaseline, Scan3dPrincipalPointU, Scan3dPrincipalPointV
- SLAM (rc_slam):
 - add services to persist and load onboard created maps (save_map, load_map, remove_map)

38.3 Other Changes

- rc_stereomatching:
 - remove force_on parameter from public interface
- rc_itempick:
 - add clustering_max_surface_rmse parameter
 - performance improvements

38.4 Fixes

- rc_stereo_ins:
 - fixed correction offsets in case of long vision outages
- rc_april_tag_detect and rc_qr_code_detect:
 - fix memory leak
 - improved matching between left and right image
- REST-API:
 - fix locking of service calls if module is not licensed
 - make log download work in tunneled/proxied environment
 - fix persistent storage of boolean parameters
- GigE Vision/GenICam:
 - fixes for better compatibility with some clients
 - some nodes like PixelFormat, Width, Height now correctly depend on ComponentSelector
 - DeviceVersion: report image version instead of rc_gev_server version

39 1.2.1 (2018-05-04)

39.1 Changes

- rc_gev_server:
 - add packet_size to status values in REST-API

39.2 Fixes

- rc_slam:
 - fixed map localization
 - fixed various internal issues
 - do "restart" when "start"ed in HALTED, so the internal state is cleared.
- rc_stereo_ins and rc_dynamics
 - fixes for communication timeouts
 - Use start on SLAM, not always restart (which drops the map)
- GigE Vision/GenICam:
 - fix race on (un)subscribing to images on heartbeat timeout
- REST-API:
 - fix loading of saved boolean parameters at startup

40 1.2.0.1 (2018-04-05)

40.1 Fixes

- rc_itempick:
 - Make sure that the grasp z-axis points into item (according to the camera z-axis)

41 1.2.0 (2018-03-29)

41.1 New components

- rc_itempick
- rc_april_tag_detection
- rc_qr_code_detection

41.2 Changes

- rc_hand_eye_calibration
 - add remove_calibration service

41.3 Fixes

- request NTP servers from DHCP
- rc_stereocalib
 - Force syncing of calibration files and images to disc
- Web GUI:
 - show hand-eye calibration images again
 - update chinese translation

42 1.1.1 (2018-02-22)

42.1 New Features

- rc_stereocamera:
 - added parameters to select a rectangular region used for calculating auto exposure:
 - * exp_offset_x, exp_offset_y, exp_width and exp_height

42.2 Changes

- rc_hand_eye_calibration:
 - provide robot_mounted bool with get_calibration service
- REST API:
 - include detailed info for all nodes (status, parameters, services) in log tarball
 - limit to 10 destinations per datastream

42.3 Fixes

- GigE Vision/GenICam:
 - immediately sync network settings to disk after changes
- Web GUI:
 - minor update to chinese translations
- fix switching of partitions via magic packet (via rcdiscover)
- improve system robustness under high load
- REST API:

- fixes for ros service call response to API mappings
- fix: correctly boot into new image if sensor is power-cycled immediately after update
- rc_stereo_ins:
 - fix initialization when camera doesn't see anything
 - improve robustness
- rc_slam:
 - autorecovery now also recovers the map
- rc_dynamics:
 - improve performance and robustness

43 1.1.0 (2018-01-19)

- Web GUI now also in French and Chinese
- new "producer" field in rc_dynamics_msgs Frame and Dynamics
- REST API:
 - fix bool parameters, actually return true/false and validate input correctly
- first release of SLAM
- rc_dynamics:
 - add start_slam, stop_slam, restart_slam services

roboception

rc_visard 3D Stereo Sensor

FIRMWARE CHANGELOG

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GitHub: <https://github.com/roboception>
Documentation: <https://doc.rc-visard.com>
<https://doc.rc-viscore.com>
<https://doc.rc-cube.com>
<https://doc.rc-random.com>
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