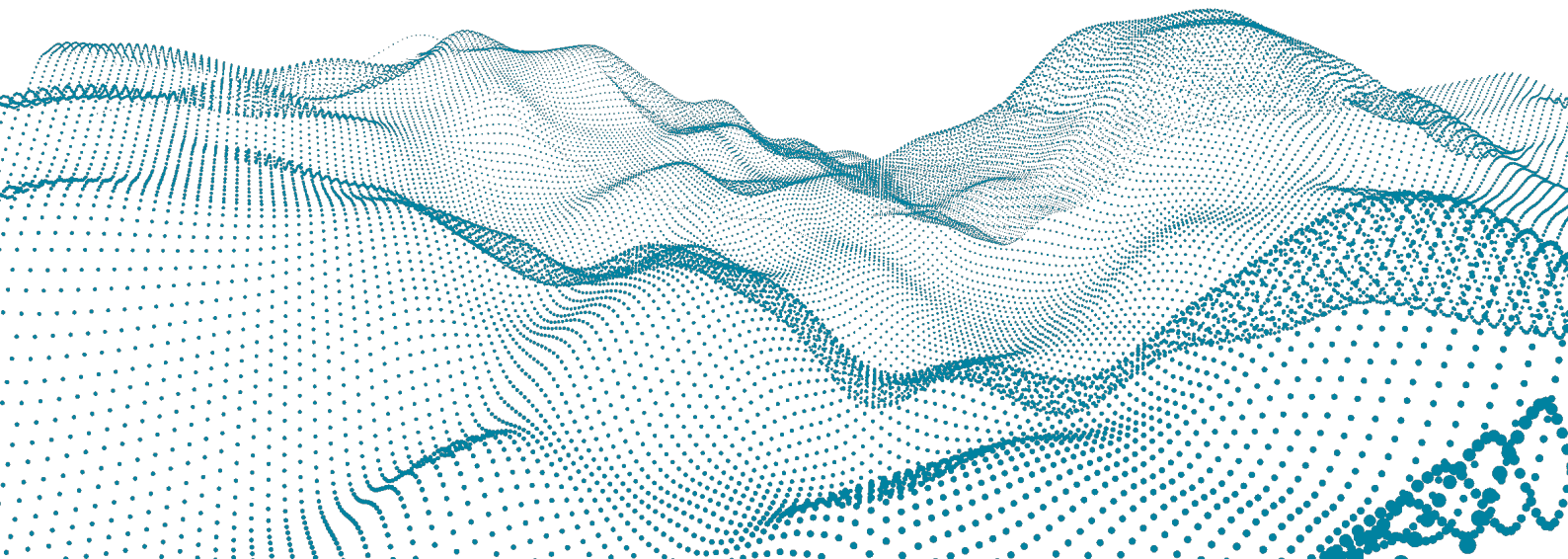
roboception

Roboception GmbH | April 2025

rc_cube Edge Computer

FIRMWARE CHANGELOG



Contents

1 25.04.0 (2025-04-25)

1.1 New Features

- CADMatch (`rc_cadmatch`): Improved performance in bin picking by computing object accessibility. The new runtime parameter `prior_selection_mode` can be set to `PriorAccessibility` to guide the refinement of detected objects towards objects that are most accessible (see Prior Selection Mode). This leads to more collision-free grasps and higher picking success rates.
- Support of Zivid cameras: The new pipeline type `zivid` can be used to configure and connect a Zivid camera to the rc_cube. The Zivid camera can be used with all its supported presets for 2D and 3D data acquisition. Additionally, user-defined presets can be uploaded to adapt to specific circumstances.
- Support Basler Stereo ace camera as pipeline of type `stereo_ace`

1.2 Improvements and Fixes

- Camera (`rc_camera`):
  - Improvements of HDR mode (require the connected rc_visard to be updated to 25.04.0):
    * More equally exposed images
    * The brightness of the image with middle exposure time is reported to ease selection of gain value
- CADMatch (`rc_cadmatch`):
  - Improvements of pose refinement for continuously symmetric objects and objects with planar surfaces
- IOControl (`rc_iocontrol`):
  - Added `out1_ratio/out2_ratio` and `out1_inverted/out2_inverted` parameters for projector control
- WebGUI:
  - Fixed grasp and match info boxes sometimes not closing by clicking on X
  - Fixed 3D result visualization in SilhouetteMatch: Missing animation of object retraction
  - Fixed triggering stereo acquisition when opening 3D result visualization
  - Added special info box for gain in HDR mode
  - Minor fixes

2 25.01.0 (2025-01-28)

2.1 New Features

- ItemPickAI (`rc_itempick`): This new module employs AI models to find objects of a given object category, e.g. `BAG`, in the scene. It uses the same interface as ItemPick and returns segmented objects with their poses and bounding boxes. Suction grasps are computed in the objects' centers so that oriented placement is possible (see ItemPickAI).
- ItemPick (`rc_itempick`) and BoxPick (`rc_boxpick`): Increased flexibility of grasp computation by considering grasp symmetries. A new runtime parameter `allow_any_grasp_z_rotation` optionally enables the computation of completely rotationally symmetrical grasp points in order to obtain maximum grasping options. Additionally, the preferred TCP orientation of the robot can be defined for automatically selecting the most suitable collision-free grasp for each item and to filter unreachable grasps (see e.g. Setting the preferred orientation of the TCP in ItemPick).
- CADMatch (`rc_cadmatch`): Added support for the next generation of CADMatch templates for more robust matching.

2.2 Improvements and Fixes

- API:
  - Added sorting of keys in JSON and UBJSON responses for better use with some optimized parsers (e.g. on Rockwell PLCs)
  - Added `system/max_power_test` which fully loads GPU (and CPU) to consume max power for 10 seconds to test the power supply.
  - Fixed bug where preferred orientations and sorting strategies were reset on firmware updates
- BoxPick+Match (`rc_boxpick`):
  - Fixed bug that led to creation of temporary phantom views
- WebGUI:
  - Show container image name in UserSpace App container details

3 24.10.0 (2024-10-24)

3.1 New Features

- ItemPick (`rc_itempick`), BoxPick (`rc_boxpick`), SilhouetteMatch (`rc_silhouettematch`) and CADMatch (`rc_cadmatch`): New sorting strategy to sort grasps and matches according to their distances from a user-defined point (see e.g. CADMatch sorting strategies)
- Added UserSpace proxy configuration
- Add CA Certificate upload functionality
- Allow calibration of rc_visard devices via the rc_cube WebGUI

3.2 Improvements and Fixes

- UserSpace:
  - Limit container logs size.
- Hand-Eye Calibration (`rc_hand_eye_calibration`):
  - Improved robustness of grid detection
- CADMatch (`rc_cadmatch`)
  - Runtime and performance improvements
- 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 or CADMatch template
  - Show self-calibration warning for rc_visard pipelines on rc_cube
  - Add option to filter database lists
  - Add option to toggle gripper element visibility
  - Allow CADMatch to use multiple pose priors in TryOut area
  - 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

4 24.07.0 (2024-07-26)

4.1 New Features

- External triggering can be configured for rc_viscore

- Manually configure additional NTP servers
- Allow UserSpace configuration via QR code
- 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

4.2 Breaking Change

- Stereo Matching (`rc_stereomatching`)
  - Moved service call `measure_depth` to new node `rc_measure`

4.3 Improvements and Fixes

- CADMatch (`rc_cadmatch`)
  - Runtime and performance improvements
- 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
- LoadCarrier (`rc_load_carrier`)
  - Improve runtime on rc_viscore images
- TagDetect (`rc_april_tag_detect`, `rc_qr_code_detect`)
  - Fix detection of tags in closer distances on rc_viscore images
- gRPC Interface:
  - Fix subscribing only to left image
- WebGUI:
  - Add filter possibility to dropdown fields and support arrow and tab keys
  - Show more container information on UserSpace page
  - Remove HDR warning for tag detections
  - Make “Exact Pose” the default when setting a pose for a load carrier
  - Add acquire button to hand-eye calibration exposure settings when in software trigger node
  - Display multiple CADMatch detections in result table and visualization when detect_objects service is used
  - Fix cut-off point cloud in 3D result visualization
  - Support arrow keys to navigate through matches and grasps in 3d result visualizations (ItemPick, BoxPick, SilhouetteMatch, CADMatch)
  - 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, a grasp or a pose prior
  - Minor layout improvements and fixes

5 24.04.2 (2024-05-15)

5.1 Fixes

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

6 24.04.1 (2024-05-08)

6.1 Improvements and Fixes

- CADMatch (`rc_cadmatch`):
  - Fix loading templates on some rc_cube S variants by ensuring that GPU driver is already initialized when starting dependencies.
- 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.

7 24.04.0 (2024-04-24)

7.1 New Features

- CADMatch (`rc_cadmatch`):
  - Add new check_collisions parameter and check_collisions_during_retraction parameter
- 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.

7.2 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:
  - CADMatch and SilhouetteMatch: Draw unchecked grasps in yellow color.
  - Gripper: keep global element and TCP pose when changing the parent

8 24.01.1 (2024-03-12)

8.1 Improvements and Fixes

- 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.
- CADMatch (`rc_cadmatch`):
  - Support templates with more advanced ICP.
- 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.

9 24.01.0 (2024-01-29)

9.1 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.

9.2 Improvements and Fixes

- Camera (`rc_camera`):
  - rc_viscore: Fixed not delivering images when HDR is turned on right after startup
- 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
- CADMatch (`rc_cadmatch`):
  - Add compartment visualization to result image
  - Improve filtering of matches inside 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 and CADMatch templates
  - Add shortcut buttons to apply grasp pose as replication origin in SilhouetteMatch and CAD-Match templates

10 23.10.0 (2023-10-30)

10.1 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.

10.2 Improvements and Fixes

- Camera (`rc_camera`):
  - Much faster adaptation of auto exposure from overexposed images for rc_viscore
- 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

11 23.07.1 (2023-09-14)

11.1 Improvements and Fixes

- Enable external1 network port on rc_cube I (only supports DHCP for now)
- Workaround igb/igc network driver bugs by lowering MTU to 1500 for those cards
- SilhouetteMatch (`rc_silhouettematch`):
  - Fix missed matches for tight ROIs
- WebGUI:
  - Move download all logs button and log level filter to top of log page
  - Fix crash on camera page when no camera is connected

12 23.07.0 (2023-07-24)

12.1 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

12.2 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:
  - show hint when HDR is not available because connected rc_visard firmware is too old
  - 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

13 23.04.0 (2023-04-28)

13.1 Improvements and Fixes

- fix spurious boot problem if USB drive is connected
- Camera (`rc_camera`):
  - fix overexposure when switching from HDR to manual exposure
- 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

14 23.01.2 (2023-03-01)

14.1 Improvements and Fixes

- Fix UserSpace containers not starting anymore due to Docker bug
- WebGUI: show warning per mountpoint if disk usage is > 90%

15 23.01.1 (2023-02-22)

15.1 Improvements and Fixes

- Fix spurious timeouts when using HDR mode
- Warn if rc_viscore is connected with less than 2000 Mbit/s
- WebGUI:
  - show result of BoxPick detect_items call
  - fix no calibration shown for Yaskawa format
  - fix firmware/license page not accessible if license is not valid

16 23.01.0 (2023-01-27)

16.1 New Features

- Added High Dynamic Range (HDR) mode for rc_viscore and rc_visard sensors
- Enhanced download of detection dumps for all reason modules:
  - up to last 5 detections
  - include stereo input images with rc_randomdom pattern
  - added trigger_dump service call which dumps the given detection to a USB drive
- SilhouetteMatch (`rc_silhouettematch`):
  - added uploading DXF files as template
- WebGUI:
  - added access control to lock Web GUI access
  - added showing available disk space under System

16.2 Improvements and Fixes

- CADMatch (`rc_cadmatch`):
  - prune PRIORITY_FILTERED grasps after collision check
  - ROI Filtering: Check more than just object centroid
  - improve detection of thin/flat objects
- 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
  - disable camera and depth snapshot buttons when camera is not ready
  - 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
  - add download buttons for last 5 detections in result tables
  - 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
- Enabled WakeOnLan for rc_cube S
- Fixed seeing projector pattern in ExposureAlternateActive mode in some images without projection when using rc_viscore
- Automatically limiting throughput if both rc_viscore cameras are connected to the same port at 1 Gbit/s, i.e. via 1 Gbit switch

16.3 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.

17 22.10.0 (2022-10-25)

17.1 New Features

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

17.2 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
- CADMatch (`rc_cadmatch`):
  - fix download of last detection for all LC models
  - fix some edge cases for high resolution images and very small objects
- 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, BoxPick and CADMatch
  - 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

17.3 Breaking Changes

- EKI Bridge (`rceki_bridge`):
  - return -5 instead of -11 on REST errors

18 22.07.0 (2022-07-22)

18.1 New Features

- TagDetect - AprilTag (`rc_april_tag_detect`):
  - add support for 41h12 family, remove 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 for rc_visard pipeline (requires 22.07 firmware on rc_visard).
- CADMatch (`rc_cadmatch`):
  - add warmup_template service.
- GigE Vision/GenICam:
  - add RcParamLockDisable, Gamma, ChunkGamma and ChunkLineMode features.
- WebGUI:
  - add 3D result visualizations to ItemPick and BoxPick
  - add option to display CADMatch and SilhouetteMatch 3D result visualization fullscreen
  - pose formats
    * extend hand-eye calibration with more pose formats
    * choose robot pose formats in Try-Outs and modals

18.2 Improvements and Fixes

- add `processing_time` status to all rc_reason modules
- change format of regions of interest and load carriers in last detection dumps to enable upload via WebGUI
- add configured sorting strategies to last detection dumps
- Hand-eye calibration (`rc_hand_eye_calibration`)
  - check and correct focal length scaling during hand-eye calibration for rc_viscore pipeline
- LoadCarrier (`rc_load_carrier`):
  - fix detection with tight ROI on viscore images
- TagDetect (`rc_april_tag_detect` and `rc_qr_code_detect`):
  - rename `tag_detection_time` status to `processing_time`
- CADMatch (`rc_cadmatch`):
  - minor fixes and improvements
  - fix loading of templates with space in template_id
  - improve return_code message if template is not supported
- 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
- GigE Vision/GenICam:
  - fix LineSelector/LineMode/LineStatus

- WebGUI:
  - camera: only hide out1_reduction in Normal
  - show accuracy of stored hand-eye calibration on status page
  - show processing_time for all rc_reason modules
  - allow CADMatch and 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
  - CADMatch: update warnings in Try Out when grasps/pose priors are changed from template section at the bottom of the page
  - 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 and CADMatch module pages
  - fix reset of preferred orientation not applied at first click on a fresh page

18.3 Breaking Changes

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

19 22.04.0 (2022-04-29)

19.1 New Features

- CADMatch (`rc_cadmatch`):
  - add optional collision checking with the point cloud. This feature checks grasps on detected objects for collisions between the gripper and a watertight version of the point cloud. The point cloud mesh used for collision checking will also be visualized in CADMatch's 3D result visualization. This feature is disabled by default and can be enabled via the `check_collisions_with_point_cloud` parameter.
  - add support for pose prior only templates. Such templates require a pose prior for detection and allow for faster detection.
  - add `data_acquisition_mode` to `detect_object` request. This allows the user to re-use the last acquired image for the next detection, which saves image acquisition time.
- Support for gamma encoding for rc_viscore

19.2 Improvements and Fixes

- gRPC interface:
  - add feature to get mesh with options for size, texture and watertight
  - add flag to request images in RGB8
- 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

  - when calibrating an rc_viscore, temporary exposure settings with good defaults are used during manual calibration
- ItemPick/BoxPick (`rc_itempick`/`rc_boxpick`):
  - runtime optimization for Full resolution rc_visard depth images and rc_viscore images
  - add timeout after 25s for BoxPick's `compute_grasps` and `detect_items` services
- CADMatch (`rc_cadmatch`)
  - increase the maximum value of the `max_matches` parameter to 30
  - increase the maximum number of CADMatch templates to 50
  - improve bounding box detection of small objects in rc_viscore images
  - runtime optimization of edge pose refiner for rc_viscore images
  - return two grasps for each taught grasp on dihedral continuous symmetric templates (e.g. rings)
  - speed-up collision checking for continuous symmetric templates
  - add warning when all detected objects are outside the load carrier or region of interest
  - use minimum of edge and surface score as output score to simplify tuning of the `min_score` parameter
- 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
- REST-API:
  - UserSpace: provide health info for containers if available
  - add sensor_interfaces to system with available interfaces and their link_speed
- 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
  - CADMatch and 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
  - interactive adding of pose priors by clicking into point cloud
  - add warning when collision checking is used without grasps in SilhouetteMatch and CADMatch
  - made axes in 3D visualizations wider
  - improve hand-eye calibration to update when new poses are added via RestAPI
  - add button to download rc_visard logs from rc_cube
  - disable reboot when system is not ready
  - show sensor interfaces on network page
  - UserSpace page: display apps and containers with status info and option to open http(s) services in iframe

19.3 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.

20 22.01.0 (2022-01-31)

20.1 New Components

- Multiple camera pipelines: The rc_cube allows multiple and different cameras (rc_visard, rc_viscore, blaze) to be connected at the same time.

  Each camera can view a different part of the scene and has an associated pipeline which enables calibration to a robot and different detection modules.

  The rc_cube S supports up to 2 camera pipelines, while the industrial-grade rc_cube I supports up to 4 camera pipelines.

  For this the software modules now either belong to one camera pipeline or are globally available database modules.

20.2 New Features

- Support for rc_viscore and blaze
- REST API:
  - introduce API v2 supporting multiple pipelines, 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
- CADMatch (`rc_cadmatch`):
  - add support for pose priors. This feature enables users to specify an indicative position and orientation for the object to detect and is recommended for applications where the object location is approximately known. Since the software does not need to search for objects in the whole image, the processing time is significantly reduced when pose priors are enabled.
  - add support for templates with new pose refinement method which aligns the object CAD model to the 3D point cloud. This is useful e.g. for objects without sharp edges and enables a wider range of objects to be handled by CADMatch.
- 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
  - add multi-camera support
  - reorganize System page in multiple pages: Firmware & License, Camera Pipelines, Network Settings, GigEVision Status, Logs

20.3 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
- CADMatch (`rc_cadmatch`):
  - performance improvements
  - sort matches as well according to selected sorting strategy
  - increase number of configurable grasps per template to 100
  - retain existing grasps on template update if the new template does not contain any grasp
  - limit maximum number of returned grasps to 100
  - increase detection timeout to 12 seconds
- 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
  - decreased loop time in CADMatch Try-Out to 1 sec
  - 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
- UserSpace:
  - free some more common ports for usage in UserSpace, see restrictions
  - support cloning of git repositories with docker-compose stack which mount config files into containers
  - add `rc_cube_monitoring` app template as docker-compose stack example
  - API v2 endpoint to query running apps and their published ports

20.4 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

21 21.10.0 (2021-10-26)

21.1 New Components

- UserSpace: New component that enables users to deploy and manage their own containers running on the rc_cube.

  The UserSpace can be used for running e.g.:

  - Collision-free motion planner
  - Web service and cloud access, monitoring
  - Vision pipelines
  - Application programs

  The REST API and gRPC interfaces can be used inside the UserSpace to obtain grasp points and image data, giving access to all activated rc_reason modules and connected sensors.

21.2 New Features

- StereoMatching (`rc_stereomatching`):
  - add exposure_adapt_timeout parameter
- CADMatch (`rc_cadmatch`):
  - add support for "partial" object templates. This feature enables CADMatch to detect only portions of a complete CAD model. Some of the use-cases that can benefit from a "partial" object template are:
    * Large objects that cannot be entirely in one camera view
    * Objects that are highly occluded when placed in a bin (e.g. large stacks of flat parts)
    * Configurable objects (e.g. a switch that can change between two configurations)
    * Partially solid objects: object that have a partially soft or changing structure (e.g. brushes)
- 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

21.3 Improvements and Fixes

- CADMatch (`rc_cadmatch`):
  - improve grasp selection for continuous symmetric templates
  - sort matches as well according to the selected sorter
  - fix no colliding grasps visualized
  - fix increasing memory usage on rc_cube S
- 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:
  - add UserSpace managament to navigation menu if available
  - 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 camera connection info to system page
  - add hint in preferred orientation visualization when z axis points towards the camera

21.4 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`.
  - Renaming of `rc_stereocamera_tl` to `rc_camera_tl`. For backwards compatibility the now deprecated name `rc_stereocamera_tl` will redirect to `rc_camera_tl`.

21.5 Deprecations

- The load_carrier services and parameters in the ItemPick, BoxPick, SilhouetteMatch and CADMatch 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 names `rc_stereocamera` and `rc_stereocamera_tl` are deprecated and will be removed in a future version. Please use `rc_camera` and `rc_camera_tl`.
- The `save_parameters` service call is deprecated and will be removed in a future version.

22 21.07.1 (2021-08-04)

22.1 Improvements and Fixes

- WebGUI:
  - fix support for gitterboxes (Early Access preview feature)
  - fix interactive grasp rotation in SilhouetteMatch template modal
- REST API:
  - return 503 (instead of 500) if service is unavailable
  - cache dongle/license validity to speed up GET system/license

23 21.07.0 (2021-07-21)

23.1 New Components

- OPC UA Server: New module that allows communicating with the rc_visard and the rc_cube 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.

23.2 New Features

- add grasp sorting strategy selection to ItemPick, BoxPick, SilhouetteMatch and CADMatch
- include grasps when downloading SilhouetteMatch and CADMatch 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:
  - 3D visualization of grippers and colliding grasps in CADMatch detection result
  - add 3D result visualization to SilhouetteMatch
  - add interactive Menus to all 3D visualizations with Controls and View Options

23.3 Improvements and Fixes

- persist parameters across firmware updates
- support writing to vfat and exfat USB flash drives
- improve system ready notification at boot
- add sensor unavailable return code for cases where the sensor is not connected or not ready
- LoadCarrier (`rc_load_carrier`):
  - add snapshot dumps for last detection
- CADMatch (`rc_cadmatch`):

  - performance and latency improvements
- 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 and CADMatch
  - 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

23.4 Other Changes

- reject IPs in internally used subnets: 172.23.42.0/24, 172.17.0.0/16
- 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.
- CADMatch (`rc_cadmatch`):
  - pose_frame is always required in detect_object arguments
- REST API:
  - node status: rename `stale` to `idle` and add `initializing`
- IOControl get_io_values service changed to support varying number of IOs

23.5 Deprecations

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

24 21.04.1 (2021-04-20)

24.1 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

25 21.04.0 (2021-04-15)

25.1 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_cube and is licensed with any of the modules ItemPick, BoxPick, SilhouetteMatch or CADMatch. Otherwise it requires a separate LoadCarrier license to be purchased.

- gRPC image streaming interface: New rc_cube 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).

25.2 New Features

- CADMatch (`rc_cadmatch`):
  - add check_collisions_with_matches parameter
- 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_cube
- WebGUI:
  - organize modules into detection modules and configuration modules
  - add import/export of grasps for CADMatch and SilhouetteMatch templates
  - new LoadCarrier detection module
  - new Regions of Interest page for configuring regions of interest for all detection modules
  - possibility to directly update the firmware of the connected rc_visard
  - add optional item maximum dimensions to ItemPick Try-Out section
  - add fullscreen control to images in stream view

25.3 Improvements and Fixes

- LoadCarrier (`rc_load_carrier`)
  - return estimated dimensions of detected load carriers
  - improve load carrier detection in low contrast scenes
- CADMatch (`rc_cadmatch`):
  - performance improvements
  - allow collision check with all detectable objects
  - disambiguate equally good grasps for symmetric templates
  - fix parsing of symmetries during refinement
- 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 CADMatch and 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

25.4 Other Changes

- support NTFS and exFAT formatted USB flash drives
- GigE Vision/GenICam:
  - set model_name to `rc_cube S` or `rc_cube X`
- REST API:
  - report if userspace is available in system

26 21.01.0 (2021-01-29)

26.1 New Features

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

26.2 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
- CADMatch (`rc_cadmatch`):
  - improve refinement for flat objects
- 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
  - show version of connected rc_visard and warn if rc_visard firmware is not supported
  - improve grasp teaching and visualization of large CAD models

26.3 Other Changes

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

27 20.11.0 (2020-11-23)

27.1 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

27.2 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
- CADMatch (`rc_cadmatch`):
  - Updated grasp sorting to also consider the matching score of the object the grasp is located on

27.3 Other Changes

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

28 20.10.0 (2020-10-13)

First release

roboception

rc_cube Edge Computer

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