Getting Started/

boujou 5.0 / Revision 3.0
www.vicon.com/boujou

boujou.

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boujou.

Contents

1 Introducing boujou 5.0
2 Installation and Licensing
3 Getting Started
4 Troubleshooting
5 Support Resources

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01/ Introducing boujou 5.0

07 **About This Guide**
08 **Related Documentation**
09 **About This Release**
09 **New Features and Enhancements**
10 Sequential Camera Solver
10 Graph Editor
10 Reference Frames/Sequences
11 Target Tracker
11 Advanced Solve Adjust
11 Labeling Tracks
11 New Instant Zoom Tool
12 Software Licensing

02/ Installation and Licensing Information

15 **System Prerequisites**
16 **Installation Preparations**
16 **Installation and Licensing Instructions**
16 Installing and Licensing on Windows
18 Installing and Licensing on Linux
19 Installing and Licensing on OS X

03/ Getting Started with boujou 5.0

23 **Preparing the Toolbox**
24 **Basic Tracking Tutorial**
24 Importing an Image Sequence
26 Tracking the 2D Features
27 Solving the Camera (Calculating the Camera Motion)
28 Exporting the Camera

04 / Troubleshooting

31 Planning and Preparation Tips
31 Shot Planning and Preparation
31 ▪ Parallax
33 ▪ 3D Depth
33 ▪ Motion Blur
33 ▪ Moving Objects
34 ▪ Large Foreground Objects Obscuring Background Objects
34 Bluescreen and Greenscreen Shots
34 AVI Codecs
35 Shots that Feature Many T-Junctions
36 Feature Tracks Tips
36 Improving the Quality of the Feature Tracks
36 ▪ Gold Tracks
37 ▪ Manual Locators
37 ▪ Target Tracks
37 ▪ Search Window
37 ▪ Camera Move and Type
38 Camera Solving Tips
38 Improving the Quality of Camera Solving
39 ▪ Drift
39 ▪ Wobble
40 ▪ Broken Camera Path
41 ▪ Bad Structure
42 ▪ Improving Results with the Graph Editor
42 ▪ Other Camera Solve Problems
43 Scene Rendering in 3D Animation Software

05 / Support Resources

45 Support Resources

Introducing boujou 5.0

01/

This guide provides basic information to enable you to install and run the current release of boujou.

About This Guide

The typographical conventions used in this book are:

Convention	Description
This type	Menus, commands, buttons, and options displayed in the GUI. Terms in a definition list or important words in a paragraph.
`This type`	Text displayed by the system or extracts of program code.
This type	Path names, file names, and extensions. Commands or text you enter.
This type	Cross-references to related information in another section or document, or to a URL.
! Important.	Information that emphasizes or supplements important points or that may apply only in special cases.
Tip.	Information on applying the techniques and procedures in the text to your specific use, or an alternative method.

Related Documentation

This guide is designed to be used in conjunction with the additional documentation for this release of boujou, shown in the following table.

Document	Description
Books	The boujou books are installed in PDF format (requires Adobe Reader version 5.0 or later, which you can download free from the Adobe website at www.adobe.com).
Tutorials	This book provides step-by-step instructions on performing specific tasks using boujou.
Reference Guide	This book describes the features and functionality available in boujou 4.1. Much of this information applies to the current release of boujou. However, there are some differences in the interface and functionality. Where there are differences, please see the relevant documentation.
Vicon website	The Vicon online support system provides a library of information that you can use to help answer your questions (for details, see Chapter 5 Support Resources).

About This Release

boujou 5.0 is the latest generation of Vicon's award-winning camera-tracking software. It provides fully automated 3D camera tracking and calibration from film and video material. In most cases no prior information about the camera or material is required, and no skilled user intervention is needed to derive the 3D information.

boujou makes it easier to add 3D objects to live camera footage in your 3D animation package by creating a virtual camera that matches the physical one that took the shot. It does this by automatically identifying features in the scene over the entire length of the shot. These features are automatically linked together into a large number of tracks. boujou then uses state-of-the-art techniques to solve the highly complex 3D mathematics in order to work out the camera parameters for each frame of the shot.

Important. Some details of the software, including the installation process, may have changed slightly since this book was printed. For up-to-date information, see the **readme** file that came with your software.

New Features and Enhancements

This section briefly describes the new features and enhancements introduced in boujou 5.0:

- **Sequential Camera Solver on page 10**
- **Graph Editor on page 10**
- **Reference Frames on page 10**
- **Target Tracker on page 11**
- **Advanced Solve Adjust on page 11**
- **Labeling Tracks on page 11**
- **New Instant Zoom Tool on page 11**
- **Software Licensing on page 12**

More details on the new features are available in the accompanying documentation.

Sequential Camera Solver

Stepped solving

You now have far greater control over the way boujou calculates the camera motion after feature tracking is finished. Instead of having to wait until the entire shot is solved, you can step through the sequence, solving one frame after the other, either forward or backward, making any changes necessary during the solve process.

Choose the frames to solve

You can choose whether boujou calculates the camera position for a range of frames, a single frame at a time, or the entire sequence.
You can solve different sections of a sequence independently.

Interrupt and restart solving

You can interrupt, make changes, and then resume solving at any point.

Graph Editor

boujou 5.0 has a fully featured Graph Editor that enables you to manipulate and adjust solve data directly. You can edit data on a frame-by-frame basis or over a range, interpolating, smoothing, changing values, copying, pasting, and deleting data as necessary.

You can then use the edited data in subsequent boujou solves.

Reference Frames/Sequences

Improve the accuracy of automated solves

You can now import one or more reference frames or sequences to your main sequence. This enables you to:

- **Add parallax information.**
- **Create genuine 3D structure for nodal pan sequences where there is no 3D information in the sequence at all.**

This new feature is particularly useful for shots with low parallax but can improve the accuracy of camera solving for many different types of sequences.

Because you can now import more than one sequence into your projects, you can choose either to create a new camera for each sequence or to use an existing camera.

When you import more than one sequence, you can choose the sequence on which to perform common tasks such as feature tracking, camera solving, and importing an image-based mask.

Target Tracker

Faster target tracking

Target tracking is now much faster, particularly in sequences involving a large search area.

Single key target tracking

You now need to place target tracks in only a single keyframe in one place in a sequence. boujou then tracks the pattern you have specified for the rest of the shot.

If you need to improve the accuracy of the tracking, you can add target tracks in further keyframes as necessary.

Multiple simultaneous target tracking

You can place more than one set of target tracks before boujou begins the tracking process and then track them all at the same time.

Advanced Solve Adjust

boujou's solve adjust function has been extended to allow locking of individual channels of translation data and the locking of all rotation channels.

You can also run a solve adjust and affect only the cameras and not the 3D structure. You can do this over a selected range of frames rather than the entire solve.

Labeling Tracks

You can now easily identify the target tracks and locators you have added, as well as all feature tracks and 3D points.

For each target track and locator you add, boujou displays a text label that gives the name and type of track. You can display the names of automated feature tracks in the 2D image window and those of survey points, predictions, target tracks, and locators in the 3D view. You can choose to display all or only selected track labels.

You can rename the labels to make them even more easily identifiable.

New Instant Zoom Tool

The Instant Zoom tool lets you display a zoomed-in view in the Image window at the press of a key. The Image window display is centered wherever you click the mouse in the Zoom Tool pane.

In this pane you can also set the zoom factor and other zoom parameters.

Instant Zoom is particularly useful when you need precise control over the position of elements in the Image window, for example when you are setting target tracks or locators.

Software Licensing

To enable faster delivery and better software management for system administrators, boujou now uses the SafeNet Sentinel software licensing system.

For details, see Sentinel RMS Development Kit System Administrator's Help, which ships with boujou. For information about how to find and read this file, see the instructions for your platform in **Chapter 2 Installation and Licensing Information on page 15.**

Installation and Licensing Information

This chapter lists the equipment you need to run boujou and provides instructions for installing and licensing the software in your chosen environment. It covers the following topics:

- **System Prerequisites**
- **Installation Preparations on page 16**
- **Installation and Licensing Instructions on page 16**

System Prerequisites

We recommend the following minimum computer specification for boujou 5.0 to run successfully:

- **Windows**
  XP SP3
  Vista SP1

- **Intel Macintosh**
  10.5 Leopard
  10.6 Snow Leopard

- **Linux**
  Red Hat Enterprise 4.X +
  Centos 4.X +
  Fedora Core 5, 8, and 10

- At least 1 GB of RAM.

- At least a 1 GHz processor (or equivalent). The processor must support SSE2 instructions. The majority of newer processors do—however, Intel Pentium III and some older AMD processors do not. The tracking software is currently not multi-threaded, so you will not see any significant improvement in performance on a multi-processor machine.

- An OpenGL graphics card.

  We HIGHLY recommend the latest manufacturers drivers are installed for your graphics adapter since there may be compatibility issues with the default drivers under some earlier Linux distribution

- A two-button mouse.

- Approximately 90 MB of disk space for the application and associated files.

- 24-bit color display.

Installation Preparations

You need the following to install and run boujou:

- **Administrative privileges to install the software and reboot your PC.**
- **The installation disc or downloaded installer.**
- **License code.**

Installation and Licensing Instructions

The following sections provide instructions for installing and licensing boujou in the three supported environments:

- **Installing and Licensing on Windows**
- **Installing and Licensing on Linux on page 18**
- **Installing and Licensing on OS X on page 19**

Important. Some details of the installation process may have changed slightly since this book was printed. For up-to-date information, see the **readme** file that came with your software.

If you have any problems during installation, contact Vicon support (for details, see Chapter 5 Support Resources).

Installing and Licensing on Windows

You can install the software in any of the Microsoft Windows environments listed in System Prerequisites on page 15.

Important. If you have a network license, you must set up a PC as a license server. You must do this even if you intend to run boujou from the computer that has the license installed. To do this you must install the license server software.

To install and license boujou on Windows:

1. Insert the installation disc or double-click the boujou 5.0 installation program icon. The installation should start automatically. If it does not, run boujou 5.0 on the installation disc.

2. A typical installation will not include the license server or licensing tools. If you are installing a network license you will need to install the license server and, optionally, the licensing tools. You may want to install the licensing tools even if you are running a node locked license. If you want to install the license server or the licensing tools, double-click the appropriate installation program icon.

3. Follow the instructions on each wizard page, completing the required details.

4. Restart your PC if prompted.

Demo version

You can run the demo version of boujou even if you don't have a license.

- There is a separate Start menu entry for the demo under windows
- Under Linux run boujou_5_0_demo
- There is a separate demo shortcut under OS X

To license boujou on a Windows system:

boujou licenses are locked to the Disk ID and the Ethernet address of the machine on which the licenses are to be installed. You will need to generate a locking code for this machine.

To do this:

1. Do one of the following:
   - Click **Start > All Programs > Vicon > Licensing > Request License**

   or

   - Run **<root directory>:\Program Files\Vicon Licensing\wechoid.exe**

   Make sure that you have **Disk ID** and **Ethernet ID** check boxes selected. **This is very important.**

   The **Selector** field at the bottom of the **wechoid.exe** window should read **0x14.**

2. Copy the locking code from the **Code** field in this window and return it to Vicon.

   You should receive an email giving you details for generating this locking code and where to send it. If you do not receive this email, contact Vicon support (for details, see Chapter 5 Support Resources). Vicon will supply you with a license file (**lservrc**) by return email.

3. After you receive your license file, your next step depends on your license type:
   - If you have a node-locked license, copy the license file into the root of your installation, in the same directory as the boujou executable.

   or

   - If you have a network license:
     - Click **Start > All Programs > Vicon > Licensing >License Manager**

     or

     - Run **<root directory>:\Program Files\Vicon\Licensing\WlmAdmin.exe.**

     All of the available license servers are listed on the left side.

     Right-click the server onto which you want to install the license and choose **Add Feature > From a File > To Server and its File.**

     The licenses appear under the server name on the left side of the **Wechoid.exe** window.

For further details of the Sentinel licensing system, its advanced functionality, and the licensing utilities that ship with boujou, see the System Administrator's Help.

To read the System Administrator's Help:

Do one of the following:

- Click **Start > All Programs > Vicon > Licensing > Licensing Help**

or

- In a browser, go to the directory: **<root directory>:\Program Files\Vicon Licensing\ SysAdminHelp**

  Open **index.html.**

Installing and Licensing on Linux

We HIGHLY recommend the latest manufacturers drivers are installed for your graphics adapter since there may be compatibility issues with the default drivers under some earlier Linux distribution

You can install boujou in any of the Linux environments listed in System Prerequisites on page 15. You can either:

- Use the supplied installation script.

or

- Copy the required files.

Please consult your System Administrator before attempting to install boujou under Linux.

Important. If you have a network license, you must set up a PC as a license server. You must do this even if you intend to run boujou from the computer that has the license installed.

To install boujou on Linux using the installation script:

1. In a shell, type:
   `sh boujou_install.sh`

2. At the prompt, specify the installation directory. The default location for installation is **/usr/local** You must have root privileges to install here; otherwise, you will be prompted to supply an alternative location:
   - If you install the software as root, you can run boujou 5.0 by typing the following command in a shell:
     `boujou_5_0`

or

- If you install the software as an unprivileged user, you must set up your path to be able to run boujou from any directory.
  To do this for the bash shell, add the following line to your **.bashrc** or **.bash_profile** file:

  ```
  export PATH=${PATH}:<boujou
  installation_directory>/bin
  ```

  To do this for the tcsh or csh shell, add the following line to your **.tcshrc** or **.cshrc file:**

  ```
  setenv PATH ${PATH}:<boujou
  installation_directory>/bin
  ```

To install boujou on Linux without using the installation script:

1. From the **Linux/bin** directory on the installation disc, copy the two files required to run boujou: **boujou** and **boujou.dat** to **/usr/local boujou_5_0_/bin**

2. Ensure that both files have executable permissions.

To license boujou on a Linux system:

1. From the installation package, copy the **licensing** directory to the location of your choice. This directory contains a range of licensing utilities.

2. boujou licenses are locked to the Disk ID and the Ethernet address of the machine on which the licenses are to be installed. You must generate a locking code for this machine. To do this, from the **licensing** directory run **echoid**.

3. Copy the locking code from the Console and return it to Vicon.

   You should receive an email giving you details for generating this locking code and where to send it. Contact Vicon support if you do not receive this email (for details, see Chapter 5 Support Resources). Vicon will supply you with a license file (**lservrc**) by return email.

4. After you have received your license file, your next step depends on your license type:
   - If you have a node-locked license, copy the license file into the root of your installation, in the same directory as the boujou executable.

   or
   - If you have a network license, from the licensing directory, install and start the license server software, **lserv.**

     Important. To start the license server, you must be logged in as root. You must then install your license. To do this, from the licensing directory run:
     `lslic -F filename`

     where `filename` is the license file provided by Vicon.

For further details of the Sentinel licensing system, its advanced functionality, and the licensing utilities that ship with boujou, see the System Administrator's Help.

To read the System Administrator's Help:
1. In a browser, go to the directory:
   licensing/SysAdminHelp

2. Open **index.html**

Installing and Licensing on OS X

You can install boujou 5.0 in any of the OS X environments listed in System Prerequisites on page 15.

Important. If you have a network license, you will need to set up a computer as a license server. You will need to do this even if you are running boujou 5.0 from the computer that has the license installed. To do this you will need to install the license server software.

To install and license boujou on OS X:
1. Ensure that you are logged on to your computer as a user with Administrative rights.

2. Insert the installation disc into your disc drive or double-click the installation package icon and run the boujou installation program **boujou_5_0.pkg**.

! **Important.** If boujou tells you that you have a negative amount of RAM in the image cache, set the amount manually in **Edit > Preferences > Miscellaneous > Total physical memory.**

To license boujou on an OS X system:

1. boujou licenses are locked to the Disk ID and the Ethernet address of the machine on which the licenses are to be installed. You must generate a locking code for this machine.

   To do this, run **/Applications/boujou5.0 licensing/echoid.**

2. Copy the locking code from the Console and return it to Vicon.

   You should receive an email giving you details for generating this locking code and where to send it. Contact Vicon support if you do not receive this email (for details, see Chapter 5 Support Resources). Vicon will supply you with a license file (**lservrc**) by return email.

3. After you have received your license file, your next step depends on your license type:
   - If you have a node-locked license, copy the license file into the root of your installation, in the same directory as the boujou executable.

     or
   - If you have a network license, from the licensing directory run:
     `lslic -F filename`

     where `filename` is the license file provided by Vicon.

For further details of the Sentinel licensing system, its advanced functionality, and the licensing utilities which ship with boujou, see the System Administrator's Help.

To read the System Administrator's Help:

1. In a browser, go to the directory: **licensing/SysAdminHelp**

2. Open **index.html**

03

This chapter shows you the basic workflow for camera tracking with boujou.

Important. In this chapter, the descriptions of the locations of the various elements of boujou refer to their default locations.

Before starting the tutorial on page 24:

1. Make sure the required shortcut buttons are present in your Toolbox. For information on how to do this, see Preparing the Toolbox.

2. Copy the sample files, **tutorial1_cottage.[###].jpg**, to your hard disk drive. You can obtain these files from either the installation disc (under **Tutorials\Tutorial_1\tutorial_1_source_images**), or the Vicon website (for details, see Chapter 5 Support Resources).

Preparing the Toolbox

The **Toolbox** contains shortcut buttons that enable you to access commonly used commands quickly and easily.

To display the Toolbox:
In the left sidebar, click the **Toolbox** tab button to make the **Toolbox** active. Make sure the **Toolbox** contains the following buttons:

- **Import Sequence**

- **Track Features**

- **Camera Solve**

- **Export Camera**

- **Preferences**

If any of these buttons is missing, add it using the following procedure.

To add a shortcut button to the Toolbox:
1. Right-click in an empty area of the **Toolbox** and from the displayed list of available shortcuts, point to the required type of shortcut and then click the shortcut name.

2. Repeat this until you have added all of the required shortcuts to the **Toolbox.**

Basic Tracking Tutorial

This tutorial demonstrates the basic tracking workflow in boujou.

It includes the following lessons in the order in which the workflow steps need to be performed:

1. **Importing an Image Sequence**
2. **Tracking the 2D Features on page 26**
3. **Solving the Camera (Calculating the camera motion) on page 27**
4. **Exporting the Camera on page 28**

Tip. For instructions on using advanced features, see the boujou Tutorials book.

Importing an Image Sequence

The first stage of the camera-tracking process is to load the image sequence that you want to track. boujou then finds features in these images, analyzes how they move, and works out the motion of the camera and the 3D structure of the scene.

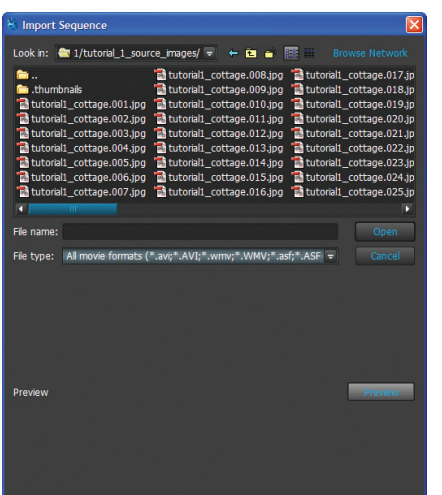
In this lesson, you will import a sample image sequence supplied with boujou and verify that boujou has used the correct camera settings.

To import an image sequence into boujou:

1. Click the **Toolbox tab** to make the Toolbox active. In the default layout, this is located in the left sidebar.

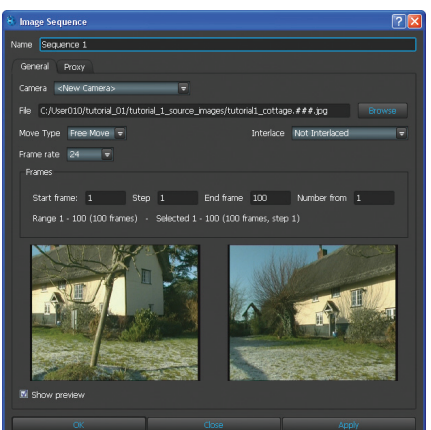
2. In the **Toolbox**, click the **Import Sequence** button.

   Two dialog boxes are displayed, with the **Import Sequence** dialog box, in which you can browse to find the required file, on top.



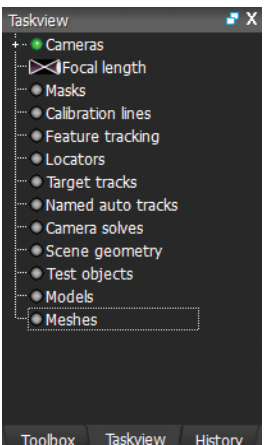
3. In the **Import Sequence** dialog box, browse for the image sequence **tutorial1_cottage.[001-100].jpg**, click the name of the first image in the sequence, and then click the **Open** button.

4. In the **Image Sequence** dialog box, leave all the settings at their default values and click **OK**.

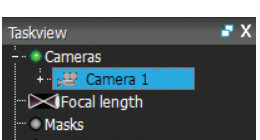


5. To check that boujou has used the correct camera settings, click the **Taskview** tab (in the default layout, this is located in the left sidebar).

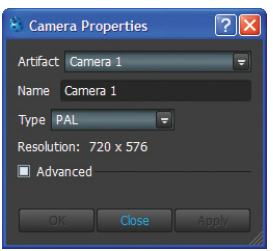
The **Taskview** pane is displayed.



6. In the **Taskview** pane, expand **Cameras** and then double-click **Camera 1**.



The **Camera Properties** dialog box is displayed. Note that boujou has correctly chosen a PAL camera type, based on the image resolution. You do not need to change any of the settings, so click **Close**.



7. Play the sequence using the **Play Controls** at the bottom of the screen. The first play-through may be slower than subsequent play-throughs as boujou loads the images into cache.

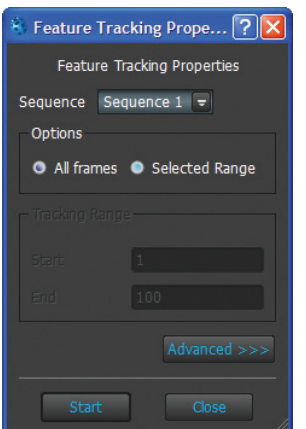
Tracking the 2D Features

In this lesson, you will learn how to track features for the image sequence you imported in the previous lesson.

To track features:

1. Click the **Toolbox** tab, then click the **Track Features** button.

The **Feature Tracking Properties** dialog box is displayed.



2. Note that **Sequence 1** is selected in the **Sequence** field. If you had imported another sequence, you would be able to select it from this list. Leave all the settings at their default values and click **Start** to begin feature tracking. Feature tracking begins from frame 0 and progress is displayed in the **Status bar** just below the main Image window.

   Feature tracking in boujou is not merely image pattern-matching, and does not have to be

perfect for each feature, so do not worry if some matches look wrong.

At this point you could select the **Solve Camera** check box, in the right side of the status bar, to make boujou start camera solving as soon as it has finished tracking the features.

For this tutorial, however, we will perform camera solving as a separate process.

3. When feature tracking is complete, play the sequence through to examine the feature tracks.

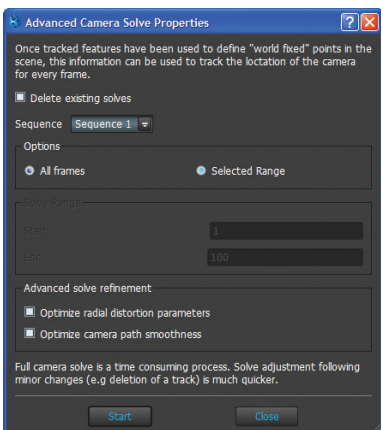
Solving the Camera (Calculating the Camera Motion)

In this lesson, you will learn how to configure boujou to calculate the camera position, orientation, and focal length, based on the feature tracks you generated in the previous lesson.

To solve the camera:

1. Click the **Toolbox** tab, then click the **Camera Solve** button.

The **Advanced Camera Solve Properties** dialog box is displayed.



2. Note that **Sequence 1** is selected in the **Sequence** field. Leave all the settings at their default values and click **Start** to begin the camera solving process.

   boujou calculates the camera position, orientation, and focal length at each frame. Camera tracking progress is displayed in the **Status bar**.

When camera tracking is complete, yellow and cyan dots appear in the Image window. These dots are called **predictions** and they show the 3D positions of the 2D features that were used to calculate the camera:

- **The yellow 3D predictions are for 2D features visible in the current frame.**
- **The cyan predictions are for features that were not found in the current frame, but that are visible in some other part of the sequence.**

Predictions exist for the entire length of the sequence, even when the features they represent are out of shot. If you play through the sequence, the predictions should look as though they are stuck to features in the images.

3. Save the project when camera solving is complete. (It is always a good idea to save your work regularly although by default boujou automatically saves your project after feature-tracking or camera-solving. You can turn autosaving off and on and change the default location of autosaved files in **Edit > Preferences > Directories**.)

Tip. If at any time you need to restart boujou and reopen your saved project, information you have added, such as predictions, may not be visible. To see them, in the Image window, right-click and then click the required option (in this case, **Predictions**), from the menu.

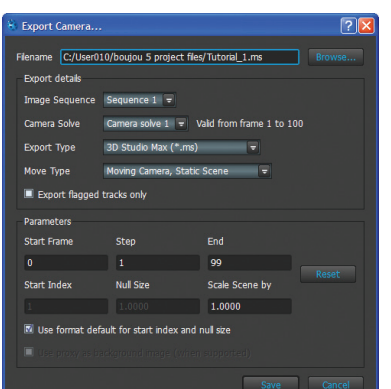
Exporting the Camera

In this lesson, you will learn how to export camera data from boujou in a format that can be used by supported third-party animation software.

To export camera data from boujou:

1. In the **Toolbox**, click the **Export Camera** button.

The **Export Camera** dialog box is displayed.



2. In the **Filename** field enter (or navigate using the **Browse** button) the location at which you want to save the exported file.

Note that **Sequence 1** is selected in the **Image Sequence field.**

3. From the **Export Type** drop-down menu, select your preferred **export format** and then click **Save**.

   The camera animation and all of the 3D predictions are exported. For more information about the various export formats supported by boujou, see Export to an Animation Package in the boujou Reference Guide.

Tip. You can specify the default export format in the user preferences. In the **Toolbox**, click the **Preferences** button, expand **Camera Export**, then expand **General**, click **Default Format** and in the drop-down menu, select your chosen format.

This completes the basic workflow tutorial. You have performed the four fundamental tasks of importing, feature tracking, camera solving, and exporting, and learned the essential concepts underlying automated camera tracking in boujou. For more information about match moving with boujou see the boujou Tutorials book.

Troubleshooting

04/

This chapter provides guidance on how to plan your shots to get the best results from boujou and how to track more complex camera moves:

- **Planning and Preparation Tips**
- **Feature Tracks Tips on page 36**
- **Camera Solving Tips on page 38**

Important. If you have additional questions or require further assistance, log on to our boujou Online Support System, at www.vicon.com/support, or contact Support at boujousupport@vicon.com. For details, see Chapter 5 Support Resources.

Planning and Preparation Tips

This section provides guidance on the considerations you should keep in mind when planning your shots to get the best results from boujou:

- **Shot Planning and Preparation**
- **Bluescreen and Greenscreen Shots on page 34**
- **AVI Codecs on page 34**
- **Shots that Feature Many T-Junctions on page 35**

Shot Planning and Preparation

If you are shooting your own footage, or if you are a VFX supervisor and have an influence over how a scene is shot, then you should be aware of what boujou can track well and what could cause problems.

The following sections offer tips on planning and preparing shots in boujou:

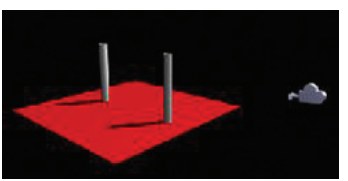
- **Parallax**
- **3D Depth on page 33**
- **Motion Blur on page 33**
- **Moving Objects on page 33**
- **Large Foreground Objects Obscuring Background Objects on page 34**

Parallax

For boujou to solve well, the shot should have plenty of parallax. If there is no parallax, boujou cannot calculate any depth information from the scene. If we look at an object from two separate points in space, we are able to perceive information about its depth. If we look at the object from a single, fixed point in space, we do not get any depth information.

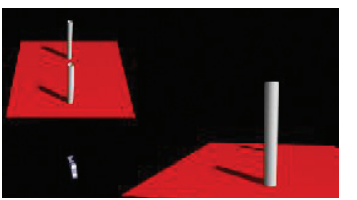
If we move our viewpoint sideways, the parallax effect provides us with a sense of where the object is in relation to its environment. The following diagrams help explain this concept further.

The following diagram shows two objects in the camera's view.



On the left side of the following figure, we see that the camera is lined up in front of the two cylinders, so it can't see that there is a second cylinder behind the first, as shown on the right side of the figure.

The following diagram shows the effect of panning the camera a few degrees to the left. It still can't tell that there is a second cylinder behind the first.



The following diagram shows the effect of panning the camera left and trucking it to the right. The camera's center is now at a different position in 3D space and it can see the second cylinder.

3D Depth

The scene should have 3D depth. Depth is the range of acceptable focus which extends both in front of and behind the principal subject of a scene. Depth of a scene is controllable to some extent through the selection of lens focal length and lens aperture. Shots without any foreground structure reduce the amount of 3D depth information available for boujou 5.0's calculations, resulting in an inaccurate 3D structure. You should make sure that you do not have a sequence where all of the trackable features lie on a plane.

Motion Blur

Motion blur conceals features and makes them less distinct. Motion blur is the natural occurrence of blur in an image as the subject moves through the frame during exposure. The amount of motion blur increases as the speed of the subject or the exposure time increases. Sudden variations in motion blur can cause boujou's feature tracking to fail, and so it is something to be avoided wherever possible. Shooting with a high shutter speed reduces the amount of motion blur in your shot (and you can always add it in again at the end as a 2D effect). You may want to consider using one of the commercially available tools for removing motion blur.

To help to track through moderate amounts of motion blur, in the **Feature Tracking Properties** dialog box, click **Advanced** and then select the **Large** option in the **Feature Scale** area.

Moving Objects

If a large amount of the image area is covered by moving objects (crowds of people, for example), boujou may get confused about what it should be tracking. Creating a mask enables you to tell boujou what to track and what to ignore.

boujou is optimized for tracking the whole scene and not for tracking moving objects in a scene. However, if the object is large enough (about 20% of the total image area) then you can get a good track by using a mask to isolate the moving object and hide the background.

boujou is not suitable for face tracking, but you can track the overall movement of the head if the actor is wearing a rigid object on their head (a hat covered in newspaper, for example). For the same reasons boujou cannot track fire, water, or smoke. These are all non-rigid bodies that move in a random way, and they generate feature tracks that move in many different directions. Leaves or grass moving in the wind can also cause problems because of the inconsistent motion of the feature tracks.

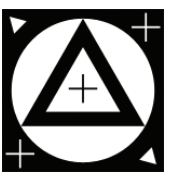
Large Foreground Objects Obscuring Background Objects
Avoid shots where a large foreground object obscures background objects. Pillars, telegraph poles, etc. can hide background features, making a shot more difficult to track and reducing the accuracy of the 3D structure. Joining tracks or using the Non-consecutive feature tracker can help to improve the accuracy of shots like these.

Bluescreen and Greenscreen Shots

Bluescreen and greenscreen studios can cause problems for boujou because of the inherent lack of trackable features. The tracking markers used in these environments are often all placed on the same plane, and this causes problems because of the mathematical ambiguity of the 3D structure.

Place tracking markers on as many surfaces as possible in order to maximize the amount of 3D depth information. They don't need to be regularly spaced, but try to put as many as you can in any area that isn't going to be obscured by the actors. Conventional circular markers do not automatically track well unless they are very small. Crosses of white tape are better, but they can cause a lot of track jumping if your search distance is too high. The target tracker can track both of these marker shapes without any problems, but it is a more time-consuming way of generating tracks.

The following marker shape was developed by Joerg Liebold at Psyop, New York, and gives good results over a wide range of conditions for both automatic and target tracks.



boujou can do a much better job if your bluescreen studio is full of items and objects. For example, if you have boxes, tables, etc. around the edges of the action, you are giving boujou a lot of vital information about the 3D structure of the shot. Paint your items blue if you have to (although wrapping a box in newspaper will give you an excellent source of tracking points and 3D information) but try not to leave large areas of flat blue or green in the shot if you can avoid it.

AVI Codecs

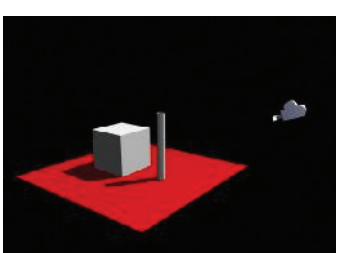
The Windows version of boujou can import any AVI file as long as you have the appropriate codec installed on your computer. Some compressors can cause feature tracking to run very slowly because boujou has difficulty extracting the individual frames from the AVI. MPEG-4 and DivX encoding seem to cause the biggest slowdown in feature tracking.

Shots that Feature Many T-Junctions

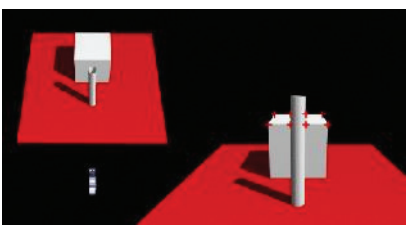
T-junctions are features that get tracked by boujou when a foreground object and a background object combine in a particular image. They are not true 3D features, so they can have an adverse effect on the accuracy of the camera solve. Deleting the T-junction tracks, or using masks to hide the objects that are causing them, improves the camera solving quality.

The following diagrams help explain this concept further.

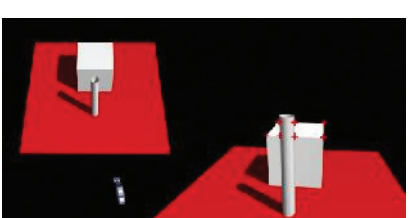
The following diagram shows a camera looking at a cylinder in front of a cube.



The following diagram shows the features that would be detected in this frame at the corners of the cube and at the apparent intersections between the verticals of the cylinder and the horizontals of the cube. These intersections form T-junctions.



In following diagram, the camera has moved up and right. This movement would be accurately calculated if just the features at the corners of the cube were used. However, the T-junctions have moved very little since the first frame and their contribution would result in an inaccurate solve. In reality there would be far more features tracked in this scene; the T-junctions would be discarded because their motion is inconsistent with the rest of the tracks.



Feature Tracks Tips

This section provides guidance on improving the quality of automatic feature tracking in boujou.

Improving the Quality of the Feature Tracks

There are several reasons why boujou can have difficulty in feature tracking certain shots. Flash frames, motion blur, film grain, rain, smoke, or fog can lead to a lack of trackable detail in one or more frames of a sequence.

If boujou cannot find any features at all in up to three consecutive frames, it jumps over the gap and continues tracking. If there are no features in four or more consecutive frames, the feature tracking is split, and two separate cameras are calculated. If you keep the **Console Pane** open during feature tracking, it will tell you if any frames could not be tracked or if any other problems occurred.

The **Feature Tracking info** window (in **Taskview**, expand **Feature tracking** then double-click **Feature Tracking**) gives you more details about how many tracks were found and how long they were. The more long feature tracks you have, then the more accurate your camera solve will be.

If there are not enough feature tracks over part of a sequence, boujou cannot calculate a single camera for that sequence. Two or more camera solution fragments will be calculated and this makes the task of adding CG objects in your 3D animation software more complicated. To avoid this, you should try to increase the number of feature tracks over the critical sections of your shot. A minimum of around 10 tracks are needed for boujou to be able to calculate a camera.

Changing the settings in the **Advanced** section of the **Feature Tracking Properties** dialog box can have a big effect on the quality of the tracks. Try using large scale features, adjusting the sensitivity, or not tracking one of the color channels.

The following sections offer tips on improving the quality of feature tracks in boujou:

- **Gold Tracks**
- **Manual Locators on page 37**
- **Target Tracks on page 37**
- **Search Window on page 37**
- **Camera Move and Type on page 37**

Gold Tracks

A good way of increasing the number of feature tracks is to make some of the good tracks gold (right click a track and select **gold** from the menu) and then do the feature tracking again. Each time

you do this, more feature tracks are created (the gold tracks are being used as a guide for the automatic tracking). You can check the number of feature tracks that have been created in each tracking pass by looking at the **Feature Tracking Info** window. Keep repeating this process until the number of feature tracks does not increase significantly and then try camera solving.

Manual Locators

Add a manual locator over the problem frames before feature tracking. A manual locator is like a feature track that you create by eye, one frame at a time. It is defined as a gold track by default and can help to guide boujou's automatic feature tracker through the problem areas. Manual locators are particularly useful if your sequence contains several frames of motion blur. An animator will probably be able to judge how a feature should be moving during motion blurred frames quite accurately, and so by adding some manual locator tracks the user can help boujou's automatic tracker.

When adding locators, aim to have at least three locator keyframes on the same frame and avoid creating single locator keyframes. Add locator keyframes on solve keyframes only.

Target Tracks

Target tracks can also be used to guide the automatic tracker. Target tracking is a semi-automatic process and can track features that would be ignored by the automatic tracker - circular bluescreen markers, for example. An entire shot could be tracked using the Target tracker.

Search Window

If your camera move is very fast then you should increase the value of the maximum search distance in the **Advanced** section of the **Feature Tracking Properties** dialog box. The search distance controls the distance that boujou looks from frame to frame for a feature that it thinks is part of the track it is building. The value set is the ratio of window size to image size in a given direction, expressed as a percentage. The default range is 1% to 20% and the search distance varies adaptively between these limits. If your shot is fast-moving or contains a whip-pan, then increasing the maximum value of search distance can help to prevent the tracks from breaking and becoming fragmented.

Camera Move and Type

Make sure you have set the camera move type to the appropriate setting before you begin feature tracking. If the camera was free to rotate and translate in the X, Y, and Z directions, then the

move type is **free move**. If the camera was only able to pan and tilt (rotate in X, Y, and Z, as though mounted on a tripod), then the move type is **nodal pan**. The nodal pan move is a special case because the shot will have no parallax at all, making it impossible to determine the true 3D structure of the scene. When boujou tracks a nodal pan shot, all of the calculated 3D predictions are placed on the surface of a sphere (see Tracking a Nodal Pan in the boujou Tutorials book).

A scene doesn't have to be shot with a tripod-mounted camera to be solved as a nodal pan. If the objects in the scene are far enough away, then a hand-held shot where the camera operator stands still but rotates from the waist can be solved as a nodal pan.

Camera Solving Tips

This section describes problems you might encounter with camera solving in boujou and suggests ways in which you can avoid or correct them:

- **Improving the Quality of Camera Solving**
- **Scene Rendering in 3D Animation Software on page 43**

Improving the Quality of Camera Solving

Camera solving should rarely fail completely. It should always return a result of some kind, but this result may not be valid for the entire sequence, and it may not be of acceptable quality for exporting to your 3D animation software. Getting a better set of feature tracks is usually the best way of dealing with a very bad camera solving result, but for less serious problems try adding locators in problem areas and then doing an **Adjust Only** camera solve. The advantage of this technique is that it gives fast feedback.

If boujou is unable to calculate a camera for the entire sequence, it tries to do as much as it can. This will give you either a single camera solve for only part of the sequence, or several solve fragments. These fragments cannot be joined together within boujou but they can be reused once you have improved the problem areas.

Localized motion blur or large, occluding objects can cause the camera solving to be split into fragments. The techniques discussed in the section Improving the Quality of the Feature Tracks on page 36 will help you to find enough feature tracks in problem areas to prevent the camera solve from splitting.

The following sections explain a number of ways that camera solving can produce inaccurate results and offer tips on improving the quality of camera solving in boujou:

- **Drift**
- **Wobble**
- **Broken Camera Path on page 40**
- **Bad Structure on page 41**
- **Improving Results with the Graph Editor on page 42**
- **Other Camera Solve Problems on page 42**

Drift

Symptoms:

- An augmenting object appears to drift away from its reference feature during a long sequence.
- A circular dolly move fails to match up at the beginning and the end.
- Predictions for an object that leaves the image are in the wrong place when the object returns.
- Certain features in the image are omitted after camera solving.

Joining feature tracks before camera solving gives boujou more information about the position of a feature in 3D space. This helps to reduce the amount of drift caused when a feature is temporarily hidden by an occluding object or goes out of frame for a time. Non-consecutive feature tracking can automatically join a large number of tracks at one time.

Make some of the longest, most accurate tracks gold and then feature track again. The automatic feature tracker tries to find more tracks like the gold ones, resulting in a better set of tracks being given to the camera solver. If you make any tracks gold, make sure that the track is good for its whole duration: not all of the tracks are visible at any one time unless you change the default track visibility settings.

A **Solve Adjust** after initial camera solving can bring about significant improvements in the quality of the camera path and the accuracy of the 3D structure, especially if you have added some locators after camera solving.

Sometimes drift is caused by lens distortion. Radial distortion can skew the 3D structure of the shot, thus preventing the beginning and end of a circular dolly from matching up, or making a CG set extension appear to drift away from the real structure.

Wobble

Symptoms:

- An augmenting object appears to jump over a short period.
- The camera path looks noisy when viewed in the 3D view.
- Error spikes appear in the residual values given in the Camera Solve Summary window.
- High error vectors can be seen when the Errors overlay is on.

Try adjusting the camera path using the graph editor.

A **Solve Adjust** can sometimes fix these problems. If not, add locators or target tracks to the problem area, feature track again over that range, and then camera solve. This helps to show boujou what it should be tracking and what it should be ignoring.

Try deleting any feature tracks associated with moving objects or T-junctions and camera solve again, or hide any moving objects with a mask and feature track.

Check with the camera operator to see if there were any changes in focal length when the sequence was being shot. If you do not tell boujou that the shot has variable focal length then it assumes that the focal length was constant and any changes are interpreted as a dolly, resulting in an inaccurate camera path and poor structure.

If the shot starts or finishes with a static camera, boujou may calculate a noisy camera path. Ignore the static frames and track just the section where the camera is moving.

Broken Camera Path

Symptom:

- A radical change in direction of the camera path when viewed in the 3D view which results in two sets of predictions for a single camera path.

This is one of the most serious types of camera solving failure. It can be caused by a combination of factors, particularly if two or more sections of the shot suggest radically different camera solutions (this can happen if your image sequence has a lot of lens distortion).

boujou enables you to use a range of tools and techniques to fix broken camera paths.

These include:

- **Correcting for lens distortion**
- **Gold tracks**
- **Target tracks**
- **Masks**
- **Advanced solve tools**
- **Model tools**
- **Copying and pasting views then optimizing the view**
- **Interpolating or solving from existing cameras (including using the graph editor).**

You can also track the sequence in shorter subsections and interpolate between them using the graph editor and advanced solve tools. When tracking in subsections you can use focal length values from a good section as a constraint to either fix or initialize subsequent sections.

Details of these tools can be found in the accompanying boujou documentation.

Important. Tim Dobbert's book, *Matchmoving: the Invisible Art of Camera Tracking* (Sybex, 2005, ISBN 0-7821-4403-9) contains a very useful chapter on how to connect two partial camera tracks in a 3D animation package.

Bad Structure

Symptoms:

- **3D structure appears to be inside out.**
- **The camera moves in the wrong direction.**
- **Strange structural anomalies.**
- **Very inaccurate 3D depth.**

You can use **Regenerate Structure** and **Filter Structure** (**3D Tasks > Solve Tools**) to provide a denser, more accurate set of 3D prediction points.

Inverted structures are usually caused by there being more background tracks than foreground tracks at the start of a shot. To cure this problem, make some foreground tracks gold before tracking the camera.

Use a mask to hide any parts of the image that may cause confusing tracks. For example: T-junctions, specular highlights on reflective objects, text overlays on the original images, or moving objects.

If your 3D predictions have very inaccurate depth, check to see if the shot was a nodal pan. A nodal pan shot has no parallax, and so boujou is unable to calculate the distance of points from the camera because the features in the scene do not move relative to one another. Solving a nodal pan shot as a free move gives you a confusing 3D structure (see tutorial **Tracking a Nodal Pan** in the **boujou Tutorials** book).

Shots where there is very little foreground structure can also result in inaccurate 3D depth. An example of this would be a shot taken out of the side of a vehicle moving quickly along a desert road. All of the foreground will be hidden by motion blur and the distant mountains will have insufficient parallax to give a good 3D structure. An accurate camera solve will probably not be possible for a shot like this unless there is so little parallax that you can solve it as a nodal pan. It can sometimes be helpful to constrain the distant predictions to a plane using planar constraints.

Lens distortion can result in structural anomalies such as flat surfaces appearing curved and 90 degree angles becoming obtuse. boujou enables you to correct lens distortion, and this is essential if you are working on a set extension project.

Changing focal length values and constraints can also affect the 3D structure. Try altering these constraints and the values to which they are set by a few millimeters and observe the effects.

If all of the solvable features in a shot lie on a flat plane, the 3D structure becomes mathematically ambiguous. The camera solve and structure calculated by boujou for a shot like this are likely to be noisy and inaccurate. This is a problem that can sometimes occur with bluescreen shots. Using target tracks can help to improve the tracking quality. Planar constraints may also help.

Improving Results with the Graph Editor
boujou's graph editor can help you to overcome many of the problems described above. By examining the curves in the graph editor you can get a clearer picture of the problem areas of a shot. For example, there may be a short noisy section on one or more of the motion curves, or even a single frame that 'spikes' out of alignment and is clearly inaccurate.

You can edit these problem regions in the graph editor and use the adjusted data to help boujou improve its results. For more information on using the graph editor, see Using the Graph Editor in the boujou Tutorials book.

Other Camera Solve Problems
More specific problems include camera moves that change from free move to nodal pan, shots in which the camera stops moving, and a free move with variable focal length.

If the move type changes from nodal pan to free move (or vice versa) during a shot, break the image sequence into sections, and import and solve them separately.

Your approach will vary depending on how much information you have about the focal length:

If the focal length is	Then
Constant and known throughout the shot	Track each section with the same value by setting the focal length constraints appropriately. To set focal length constraints, open the **Focal Length** dialog box **(Setup > Edit Focal Constraints)**.
Constant but unknown	Solve the free move section then use the focal length value from this solve in the pan section.
Varied across the sections	Solve the free move section then use a variable initialized constraint in the pan section to find the start or end focal length.

If the camera is stationary at the start or end of a free move shot, ignore the stationary frames and track only the moving section.

Camera solving gives inaccurate results if any of the input parameters are incorrect. Check that the move type, the pixel aspect ratio, the focal length, and the interlacing options have all been set to the appropriate values.

Important. Tim Dobbert's book, *Matchmoving: the Invisible Art of Camera Tracking* (Sybex, 2005, ISBN 0-7821-4403-9) contains a very useful chapter on how to connect two partial camera tracks in a 3D animation package.

Scene Rendering in 3D Animation Software

Symptom:

- **CG objects seem to wobble when rendered in 3D animation software**

Even though your camera solve looks perfectly matched in boujou, sometimes when you render the scene in your 3D animation software the CG elements will seem to wobble relative to the background images. The most common cause of this problem is that your camera animation frame numbers do not correspond with the correct image frame numbers. Check the frame number of the first frame of the camera animation.

Another common cause of this problem is that the camera animation and the timeline have been set to different frame rates in your 3D animation software. Check your motion curve editor to make sure that the camera keyframes line up with the frames on the timeline. boujou defaults to exporting the camera animation at 24 frames/second unless you change the value in the **Import Sequence** dialog box (**Setup > Edit Sequence**):

- **If the wobble is constant throughout the sequence, then it is caused by mismatched frame numbers.**
- **If the wobble seems to get worse towards the end of the sequence then it is caused by mismatched frame rates.**

This problem is most frequently reported by XSI users. If you are an XSI user, then we strongly recommend that you carefully read the section Importing the Scene into Softimage XSI in the chapter Export to an Animation Package in the boujou Reference Guide.

Support Resources

05

This chapter describes the resources available to you to obtain support for your use of boujou.

If you have a technical support query, go to the Support page on the Vicon website: www.vicon.com/support

Here, you can search through an extensive list of FAQs, or you can **Log a Case** to submit support requests to our technical support team. All users with an up-to-date support contract will have a log-in name and password for full access to the website. If you have not yet received your log-in details, please contact us at boujousupport@vicon.com.

When reporting a bug, please try to supply as much of the following information as possible:

- **Company name**
- **A description of the bug with steps to reproduce the problem**
- **boujou software version number**
- **Operating system**
- **Image size, format, and number of frames**
- **Example images or screen grabs**

Notes

Notes

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