Terminology

This page contains a glossary of common terms used in V-Ray.

General Terms

Adaptive Sampling

Related terms: Early Termination

Early termination (or adaptive sampling) is a technique for reducing the samples taken for evaluating a blurry value. This basically works by looking at the samples as they are computed one by one and deciding, after each new sample, if more samples are required. Early termination is used throughout V-Ray for all blurry values. (See also: Importance sampling)

Adaptive Lights

Adaptive lights is a method of evaluation of light contribution in a scene with multiple light sources. It uses information from the Light Cache to select which lights to sample. If Light Cache is not set, light tree sampling is used.

Anti-aliasing

Related terms: Image Sampling

Anti-aliasing is a special technique for producing smooth images of high-contrast edges and small details in materials and objects. V-Ray achieves anti-aliasing by taking additional image samples where necessary. To determine if more samples are needed, V-Ray compares differences in color (and/or other properties) of neighboring image samples. This comparison can be performed in several ways. V-Ray supports fixed, simple 2 level, and adaptive anti-aliasing. Anti-aliasing settings can be found under V-Ray's **Image Sampler** settings. (See also: G-Buffer Anti-aliasing)

Area Lights

Related terms: Rectangle Light

An area light is a light source that has a discrete size. These types of light sources produce both shadows and speculars accurately, closely matching real-life lights. V-Ray supports rendering of area lights through **VRayLight**. (See also: Area shadows)

Mesh Light

Mesh Light is a type of area light that turns a mesh object into a light source. It allows the creation of complex-shaped light fixtures.

Light Material

Light Material turns a mesh object into a light source. It is generally used for producing self-illuminated surfaces.

Area shadows

Related terms: Soft Shadows

Area shadows are blurred shadows (or shadows with blurred edges) that are caused by non-point light sources (**Area lights**). V-Ray is capable of producing the effect of area shadows either through **VRayShadow** or through **area lights**. (See also: Area lights)

Bucket

Related terms: Region, Rendering Region

A bucket is a rectangular part of the current frame that is rendered independently from other buckets. The division of a frame into rendering regions allows for optimal resource utilization (CPUs, PCs, memory). It also allows for more efficient distributed rendering. (See also: Distributed Rendering)

Caustics

This is the effect of light refracted by a non-opaque object hitting a (diffuse) surface.

Convergence

V-Ray's adaptive image sampler collects variance-based statistics about the current and the surrounding pixels and uses it to calculate the "noise" of the current pixel. If the calculated noise is lower than the set noise limit (threshold), then the pixel is converged.

Depth of Field (DOF)

Depth of field is the effect of having a particular plane in the scene to appear focused (sharp) and the rest to appear out of focus (blurry) depending on camera shutter properties and the distance from the camera. This is similar to how real world cameras work. Depth of field settings are usually found under the **V-Ray Camera**.

Distributed Rendering (DR)

Distributed rendering is a technique for utilizing all available computational resources (usually all machines in a local network). Overall DR assures that V-Ray makes the most out of your equipment when rendering a single frame.
When rendering in 3ds Max, the standard network rendering should be used for rendering animation sequences as it may be more efficient. (See also: Net work Rendering)

Render Server

A *render server* is one of the computers in the network that does the rendering work. A render server requests render data from the render client, processes it, and sends the result back. In any DR job, there can be many render servers.

Render Client

The render client is the computer from which the rendering is started. V-Ray must be running on this computer in order to start DR. The process initiated by the render client divides the frame into rendering regions and distributes them among the render servers, and later collects the results. In any DR job, there is only one render client.

Embree raycaster

By default, V-Ray uses the Intel Embree raycaster. For more information, see the official Intel Embree site.

G-Buffer

This term describes the collection of various data generated during image rendering. These could be Z-values, material IDs, object IDs, non-clamped colors, etc. This has proven to be very useful for performing post-rendering image processing. (See also: G-Buffer Anti-aliasing, Image Sampler)

G-Buffer Anti-aliasing

V-Ray is capable of anti-aliasing the rendered image based on the differences in one or several G-Buffer channels. (See also: Anti-aliasing)

HDRI (High Dynamic Range Image)

A High Dynamic Range Image is an image containing a high-dynamic range of colors (with components exceeding the range 0.0-1.0, or 0-255). This type of image is often used as an environment map to light the scene with natural light.

Importance Sampling

Importance sampling is a technique for basing the number of samples required for evaluating a blurry value on the effect that value has on the final result. For example, dark materials require fewer samples for evaluating GI than bright materials; dim area lights can do with less samples than bright lights etc. Importance sampling is used throughout V-Ray for all blurry values. (See also: Early termination)

Index of Refraction (IOR)

The index of refraction is defined as the speed of light in vacuum divided by the speed of light in a given medium. IOR = C/V, where V is the light speed specific for the different mediums.

Material	Index
Vacuum	1.00000
Air at STP	1.00029
Ice	1.31
Water at 20 C	1.33
Acetone	1.36
Ethyl alcohol	1.36
Sugar solution(30%)	1.38
Fluorite	1.433
Fused quartz	1.46
Glycerin	1.473
Sugar solution (80%)	1.49
Typical crown glass	1.52
Crown glasses	1.52-1.62
Spectacle crown, C-1	1.523
Sodium chloride	1.54
Polystyrene	1.55-1.59
Carbon disulfide	1.63
Flint glasses	1.57-1.75
Heavy flint glass	1.65
Extra dense flint, EDF-3	1.7200
Methylene iodide	1.74
Sapphire	1.77
Heaviest flint glass	1.89
Diamond	2.417

Indirect Illumination (GI)

Related terms: GI, Global Illumination, Global Lighting

In the real world, when a ray of light hits an object, it produces multiple reflected rays with different intensity in all directions. These rays on their turn may hit some other objects and produce even more rays and so on. This process, multiply repeated, generates what is called Global Illumination. For more information, see the Indirect Illumination Reference page.

Light Cache

Light caching (sometimes also called light mapping) is a technique for quickly approximating the global illumination in a scene. The light cache is built by tracing many, many eye paths from the camera. Each of the bounces in the path stores the illumination from the rest of the path into a three-dimensional structure. This method is developed by Chaos specifically for the V-Ray renderer. See Light Cache GI for more information.

Irradiance map (deprecated)

Indirect Illumination in V-Ray is generally achieved by calculating GI samples. The irradiance map is a special cache where V-Ray keeps precalculated GI samples. During the rendering process when V-Ray needs a particular GI sample, it computes it by interpolating the nearest precalculated GI samples stored in the irradiance map. Once computed, the Irradiance map can be saved in a file and reused in subsequent renderings. This can be especially useful for camera fly-through animations. Samples for VRayLight can also be stored in the irradiance map.

Motion Blur Analytic Sampling

This is one of V-Ray's techniques for calculating motion blur. Instead of taking a number of time samples, the analytic method blurs the moving triangles perfectly. It takes in consideration all triangles crossing a given ray during a given time interval. Keep in mind that because of its precision this method is extremely slow on high-poly scenes with fast motion. (See also: Motion blur, Quasi Monte Carlo sampling)

Low Accuracy Computations

In certain cases, V-Ray does not need to compute a ray contribution to the final image with absolute precision. V-Ray then uses faster but less precise computation methods and takes fewer samples. This produces slightly noisier results, but decreases rendering times.

(Quasi) Monte Carlo Sampling

Related terms: DMC (Deterministic Monte Carlo), QMC (Quasi Monte Carlo), Monte Carlo

Monte Carlo sampling is a method for numerical computation of integrals of functions by evaluating these functions at a number of random points. Quasi Monte Carlo sampling is a modification of this method, which instead of randomly generated points, uses points forming a low-discrepancy sequence, which are more evenly distributed than purely random ones. This is the method used by V-Ray to evaluate complex effects such as global illumination, blurry reflections, depth of field, motion blur and image anti-aliasing.

Motion Blur

This effect is observed when looking at a fast-moving object. The motion is so fast that one can not focus the object, and the object's image appears blurred to the viewer. Motion Blur parameters can usually be found under the **V-Ray Camera** settings. (See also: Analytic sampling, Monte Carlo sampling)

Photon Map

Related terms: Photon

This is a simulation of real world photons (light particles). To produce effects like caustics, V-Ray traces certain amount of photons that come out of the light sources. Then the results are stored in a photon map and used during rendering so that highly realistic caustic effects are produced.

Reflections

As an advanced ray tracer, V-Ray supports accurate reflections. Glossy reflections are supported as well. See also BRDF.

Refractions

Refraction is the bending of a wave when it enters a medium where its speed is different. The refraction of light when it passes from a fast medium to a slow medium bends the light ray toward the normal to the boundary between the two media. As an advanced ray tracer, V-Ray supports true accurate refractions. V-Ray also handles glossy refractions.

Russian Roulette

This is a technique for reducing variance (i.e. noise) by eliminating computationally intensive paths with little or no contribution to the final image, without introducing bias.

Translucency

Translucency is a term describing the interaction of light with a non-opaque medium (wax, marble, skin, etc.). V-Ray supports various translucency models that can produce natural results. Translucency options are found in the **V-Ray Material**, and specialty materials like FastSSS2, AlSurface or the 2-Sided material.

BSDFs

The Bi-directional scattering distribution functions are used in computer graphics to simulate how light interacts with surfaces and materials. They provide a good approximation to real-world light behavior in rendering. Note that no principled model is able to represent all possible materials entirely accurately, and where those models fail in some edge cases - only approaches such as that of Chaos Scans (see BTF) are able to capture the correct material representation.

BRDF

The bidirectional reflectance distribution function (BRDF) describes how light from an incoming direction is reflected towards an outgoing direction. The function computes the ratio of the reflected radiance to the incoming radiance. The most common ones are available in V-Ray Material. They include the Microfacet GTR (GGX), the outdated microfacet Blinn and Ward, and the Phong models.

Microfacet GTR (GGX)

GGX is the most modern and flexible BRDF type in V-Ray and is able to better represent a broad range of materials thanks to its ability to control the shape of the specular lobe.

There currently isn't any particular performance difference between models, and there is little reason to choose any of the other types.

Historically, the Phong, Blinn, Ward, and GGX are successive reflectance models developed over the years in computer graphics where each model aimed to improve on the limitations of the previous ones. For example, the specular highlights with the Phong model have a very narrow and bright center with no falloff, but it doesn't work well with anisotropic reflections. The Blinn model has a broader highlight center with a tight falloff. The Ward model has an even broader center and falloff. The GGX model has a bright center and an even longer falloff (at default settings). In the past, each model's characteristics resembled more closely a certain type of material, for example, Phong could be used for plastics, Ward for cloth and metals, and Blinn for other common surfaces. However, with the introduction of the GGX model, all of these surfaces can be approximated well, thus reducing the need for using the other models.

Related papers: Microsurface Transformations by Asen Atanasov, Vladimir Koylazov, Rossen Dimov, Alexander Wilkie

BSDF

Related terms: BRDF

The Bidirectional Scattering Distribution Function helps us define how light scatters off of a surface. BSDF is generally a combination of the reflected and absorbed light at the surface (BRDF) and the transmitted light (BTDF) and is used to determine how the light coming from a certain direction is distributed in other directions.

BTDF

The Bidirectional transmittance distribution function is similar to BRDF, however it relates to rays that are transmitted, exiting from one direction in the opposite hemisphere of the incident ray.

BSSRDF

The Bidirectional scattering surface reflectance distribution function is a model describing light transfer beneath the surface of a material that exhibits strong subsurface scattering qualities.

BTF

Related terms: BRDF

Bidirectional Textured Function (BTF) represents BRDF as a function of the space position (usually provided as UV coordinates). There are multiple ways to represent mapped BRDFs, but in most cases, the term "BTF" is used to describe one certain approach. The approach is based on multiple (thousands) real images taken under different observation angles and lighting. BTF calculates the view of the material by weighted blending of several of these images, depending on the shading context.

Key V-Ray Terms

Subdivs

In V-Ray, subdivs is a measure for the maximum amount of samples (rays) that V-Ray uses to compute a certain value. The maximum number of samples is proportional to the **square** of the subdivs value. For example, if the subdivs value for sampling a glossy reflection is 4, V-Ray will never make more than 4 x 4 = 16 samples to evaluate the reflection.

Distributed Rendering

A rendering method of dividing frames (images) into regions (buckets) and rendering them on different render nodes (machines) by using V-Ray DR spawner or V-Ray render server. (See also: Distributed rendering)

Network Rendering

A method for letting each render node (machine) render an entire frame (image), for example by submitting jobs to job managers like Backburner.

Render Node

A machine that performs the actual rendering.

V-Ray DR spawner

A V-Ray tool used to start 3ds Max in server mode for Distributed Rendering. (See also: Distributed Rendering and Set Up Distributed Rendering)

V-Ray SDK

A low-level software development kit used for creating custom V-Ray materials and geometry.

V-Ray App SDK

A high-level software development kit, allowing control over V-Ray's feature set. Useful for integrating V-Ray into any application or for creating and editing V-Ray data in an automated way.

VRIMG

VRIMG is Chaos's proprietary image file format. It is used by the V-Ray Frame Buffer to store the rendered image incrementally (bucket by bucket) while rendering in full floating-point format, with all available render elements. It can be used as the rendering output format, but it is not recommended to use it as a texture file format. VRIMG contains metadata, i.e. render statistics. It supports dynamic bucket size. VRIMG can be saved just as any other image format – it can either be the render output format or it can be saved from the VFB.

VRSCENE

The *.vrscene* file format is a text file that uses UTF-8 encoding (without BOM) and can be exported from all platforms that use V-Ray. It contains all the information about the scene such as geometry, lights and shaders, and can be rendered with V-Ray Standalone or referenced as an asset into any application that has V-Ray integrated. Vrscene is Chaos' proprietary file format.

VRMESH

The .vrmesh file format holds data for meshes, hair and particles. It contains all geometric information for a mesh including vertices and face topology, texture channels, face material IDs, smoothing groups, and normals. It can also include point cloud data. Materials are not saved in the file. The .vrmesh file format stores its meshes preprocessed and subdivided into chunks for easier access. VRMESH is Chaos' proprietary file format.

VRPROG

Sidecar file for tracking checkpoints during resumable rendering. It is used with **Progressive** image sampling. VRPROG is Chaos' proprietary file format.

VRLMAP

VRLMAP is Chaos' proprietary file format that stores pre-computed Light Cache global illumination data. The .vrlmap does not include the prefiltering of the light cache; prefiltering is performed after the light cache is loaded, so that you can adjust it without the need to recompute the light cache.

VRST

V-Ray's native deep image file format which was used before the release of OpenEXR 2. VRST is Chaos's proprietary image file format.