Screen Space Ambient Occlusion (SSAO)

Description

SSAO effect applies soft shadowing to screen space geometry utilizing screen depth texture to reconstruct world positions. A set of rays is cast in the hemi-sphere which is aligned to surface's normal. The normal to align with is either calculated either using adjacent pixels or is taken from the normal buffer of the scene, which is constructed for deferred lighting stage. Randomly oriented set of rays is checked against local geometry to determine which percentage of the rays is occluded. Based on this percentage, shadowing is applied. After initial SSAO pass is complete, custom separable blur pass is performed. This blur accounts for depth discontinuities to prevent SSAO shadowing from leaking into "unrelated geometry".

Based on the quality settings, SSAO effect may be rendered into half resolution buffer, or with optional additional ray casting to fine tune SSAO appearance. This additional ray casting is configured using separate settings set.

With certain terrain settings, it is possible to get poorly tessellated terrain geometry in front of the camera. If this is the case, SSAO effect may produce unpleasing results, revealing this poor tessellation, which is not as apparent when SSAO is off. In order to counter this, special rendering scheme is implemented. Terrain depth is rendered into a separate buffer. This buffer is then blurred and the rest of geometry is overlayed over it. This combined buffer is then used for SSAO effect. This technique is not in the engine as "**double depth ssao**"

Associated code

RenderSSAOEffect ()	Function that performs SSAO rendering
BlurSSAO(..)	Function that performs SSAO "depth sensitive" blurring
r_ssao_method	Config variable that chooses SSAO rendering method May one of the following: *SSM_DEFAULT*(1) *SSM_HQ*(2) - casts more rays using standard settings set and performs additional ray casting with separate settings set as described above
r_half_scale_ssao	Config variable which determines if SSAO should be rendered in half resolution buffer. Set to non-zero value to indicate the need to render into half resolution buffer.
r_optimized_ssao	Config variable which determines if optimized SSAO shader is to be used. This optimized shader performs ray randomization procedures in a way, which increases performance, but lessens uniformity of noising.
r_ssao_quality	Config variable that stores ssao quality selected by user from the options menu
r_double_depth_ssao	Config variable that specifies whether double depth SSAO is enabled or not (see description above)
ssao_ps.hls	SSAO Shader
SSAOSettings	SSAO parameters struct

Associated Source Files

DrawWorld.hpp	Among other things, contains *RenderSSAOEffect ()* and *BlurSSAO(..)* definition.
CommonPostFX.h	Among other things, contains *SSAOSettings* declaration
CommonPostFX.cpp	Among other things, contains *SSAOSettings* instances
Vars.h	Header file for all config variables

struct SSAOSettings

Summary:

Contains parameters for the SSAO effect. Individual set of parameters is kept for Default and HQ SSAO rendering method (see *r_ssao_method*)

This structure has the following fields:

Radius	*float*	Base SSAO radius affects the size of hemisphere within which the rays are cast.
DepthRange	*float*	Depth range affects the scale of the hemisphere in camera Z direction.
Brightness	*float*	Brightness of the SSAO effect
Contrast	*float*	Contrast of the SSAO effect
BlurDepthSensitivity	*float*	Sensitivity of SSAO blurring. The bigger this number is, the closer depth values are required for blurring to occur.
BlurStrength	*float*	Strength of SSAO blurring
RadiusExpandStart	*float*	Start of the SSAO radius expansion in terms of screen depth.
RadiusExpandCoef	*float*	Radius expansion coefficient
DetailPathEnable	*int*	Enable or disable additional ray casting with separate settings.
DetailStrength	*float*	Amount of additional shadowing calculated for *DetailPathEnable == 1* to mix in
DetailRadius	*float*	Hemisphere radius for detail path
DetailDepthRange	*float*	Hemisphere scale along camera Z direction for detail path
DetailRadiusExpandStart	*float*	Start of the SSAO radius expansion in terms of screen depth for detail path
DetailRadiusExpandCoef	*float*	Radius expansion coefficient for detail path.
DetailFadeOut	*float*	Regulates how fast will detail shadowing decay with distance to prevent SSAO artifacts relevant to small hemisphere radius to appear.
BlurTapCount	*int*	Number samples for blurring SSAO shadowing
BlurPassCount	*int*	Number of passes of SSAO blurring