

**White Paper** | Order Independent Transparency  
(OIT) in PTC Creo Parametric 2.0



# Overview:

OIT Definition: Order independent transparency or "OIT" in computer graphics programming terminology denotes any technique that can correctly render overlapping semi-transparent objects without having to sort them before they are being rendered.

Rendering semi-transparent objects has always been a problem because the blending operation is order dependent: when a semi-transparent fragment is rendered, the underlying color (i.e. the background) is crucial for the final color to be correct.

Previous known method including face sorting, triangle sorting or depth-peeling (multi-pass) are not totally accurate and have a huge burden on the rendering pipeline and requires preparation on the CPU side. In addition, this work is view orientation dependent and need to be redone every time the view point changes.

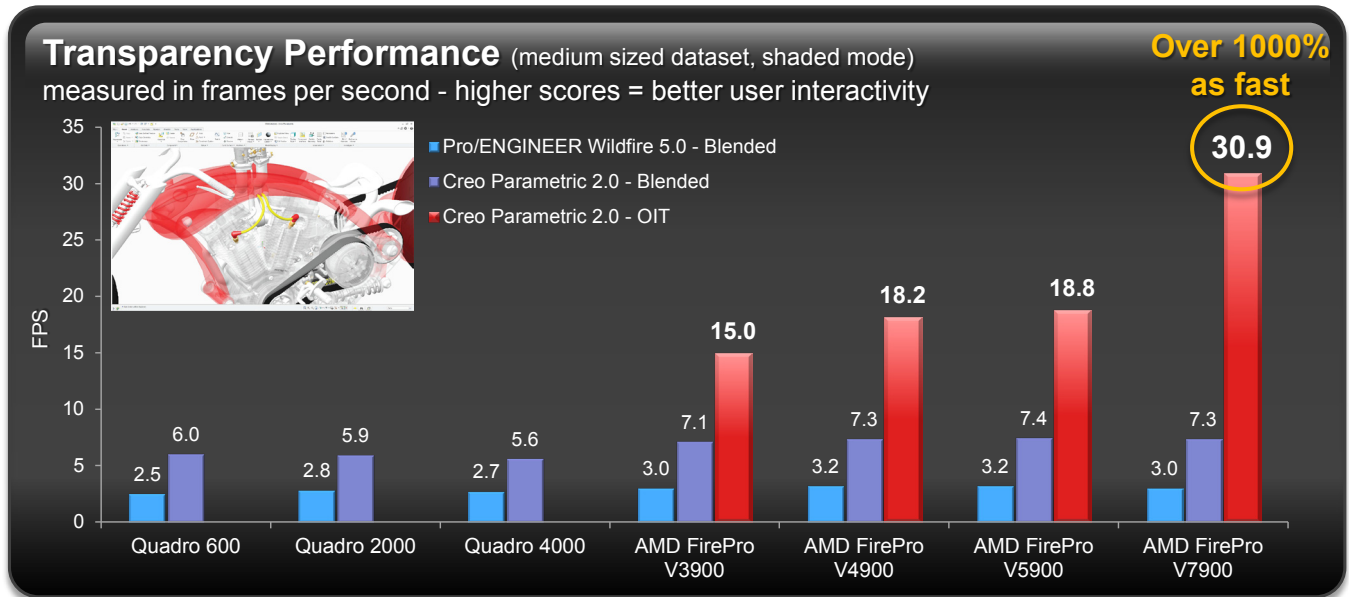
The OIT technique implemented in PTC Creo Parametric 2.0 allows for pixel accurate rendering of overlapping semi-transparent objects without having to sort them before they are being rendered, providing up to 10 times performance of blended rendering in PRO/Engineer Wildfire 5.0 compared to when rendering transparency in Creo Parametric 2.0.

With PTC Creo Parametric 2.0 the OIT feature means much less time wasted waiting for your model to render and increased productivity over the long run.

<b>Feature</b>	<b>Description</b>	<b>End User Experience</b>	<b>Workflow Benefit</b>
OIT "Order independent transparency"	Provides GPU accelerated transparency in Creo Parametric 2.0 when running on AMD FirePro professional graphics	Up to 10 times frame rate with "OIT" transparency mode enabled with AMD FirePro professional graphics	Smooth viewport interactivity helps increase designer productivity "Holistic" design awareness that can improve designer intuition and overall decision-making effectiveness Fully-Interactive transparency mode opens the door for innovative, novel 3D CAD workflows
OIT "Order independent transparency"	Provides GPU accelerated "Pixel-accurate" depth sorting	Helps ensure that assemblies and components are accurately represented in context of the surrounding geometry	"Holistic" design awareness can improve designer intuition and overall decision-making effectiveness Proximity and collision analysis are simplified and made more efficient

# Transparency Performance

Blended vs. OIT Transparency (medium sized dataset, shaded mode)



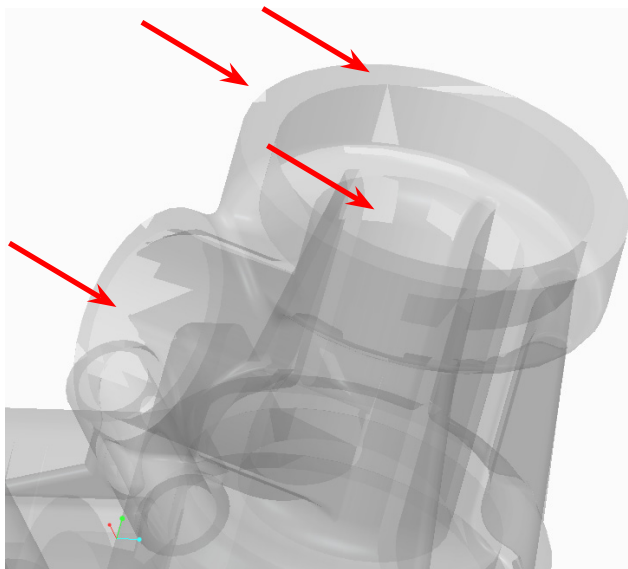
PTC Motorcycle assembly  
Dell T3500, Intel Xeon W3690 3.47Ghz 6-Core, 12GB, Windows 7 x64, 1920x1200  
Creo Parametric 2.0 F000, Pro/E Wildfire 5.0 M060  
Drivers: AMD FirePro 8.911.3.3, Nvidia Quadro 295.73

## Benefits: easy, accurate and fast

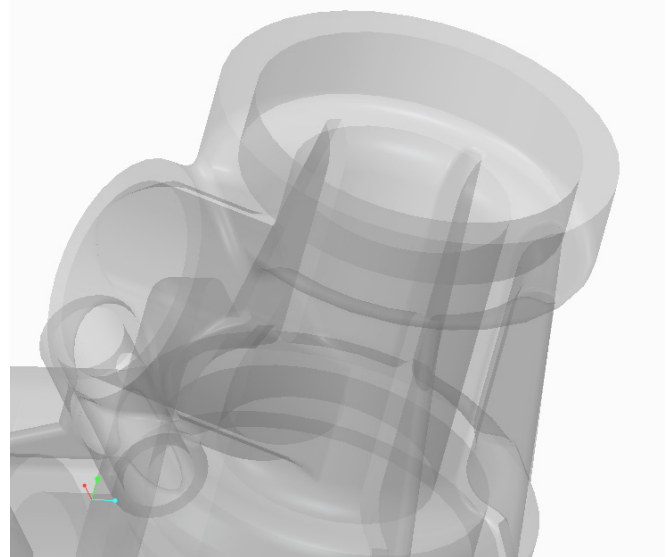
This technique is easy to implement and add to an existing rendering pipeline: everything can be rendered as usual, semi-transparent or not. The technique exposed here is fully implemented on the AMD FirePro professional graphics board, it totally frees the CPU from multiple render passes or face sorting.

It is also very accurate since the actual sorting that happens on the GPU is done per fragment.

That technique has a very low impact on the existing rendering pipeline and is therefore very easy to integrate in an existing rendering engine.



Note some triangles not blended correctly



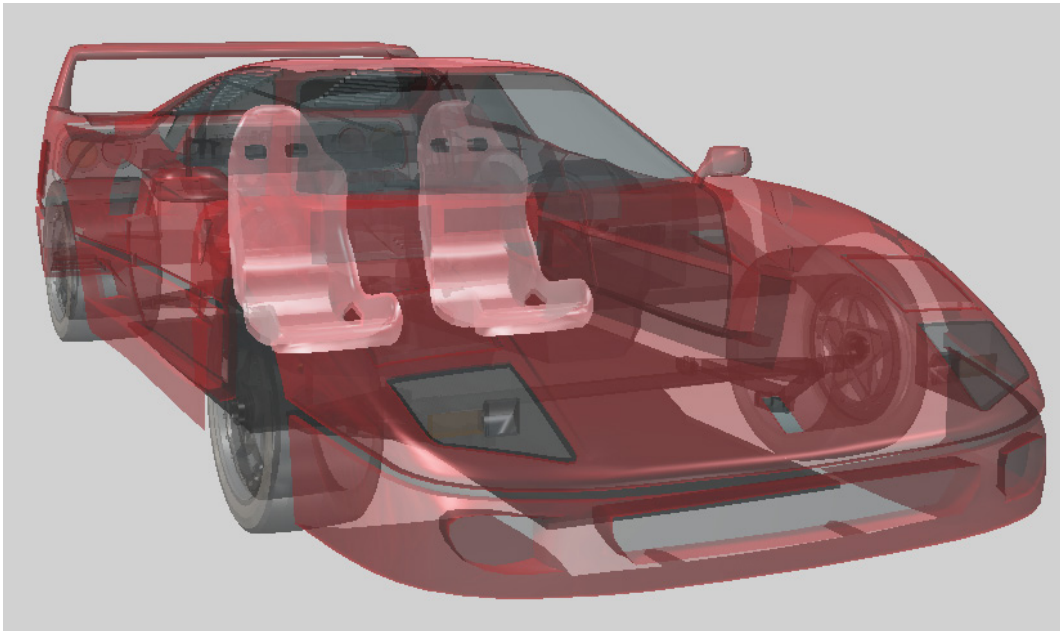
With OIT technique, it is pixel perfect

As far as performance goes, the results speak for themselves: it achieves up to 10x faster frame rate compared to face sorting and regular blending.

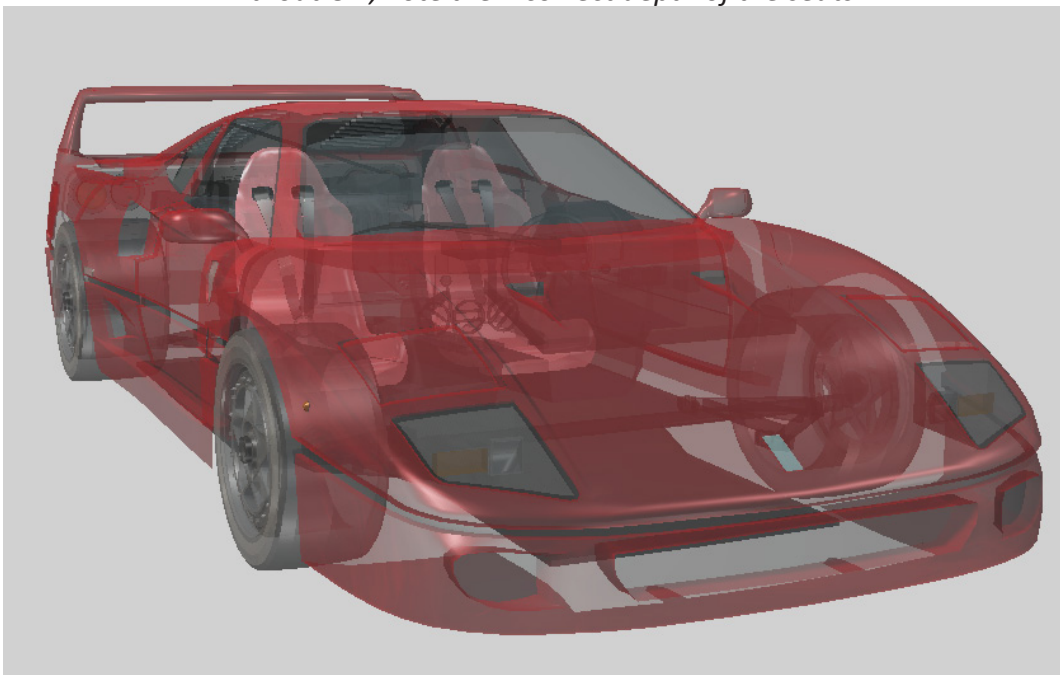
## Technique:

The technique is based on the usage of an A-buffer, a simple list of fragments per pixel, in its simplest form as a linked list of fragments per pixel. First, all primitives are rasterized to the A-Buffer, writing some color value and some depth value (Red-Green-Blue-Alpha-Depth), one index buffer (RAT) is used to keep the number of fragments in this pixel. Finally, a full screen shader pass will sort that A-Buffer according to the depth value and do the blending for each fragment according to their sorted indices.

## Result:

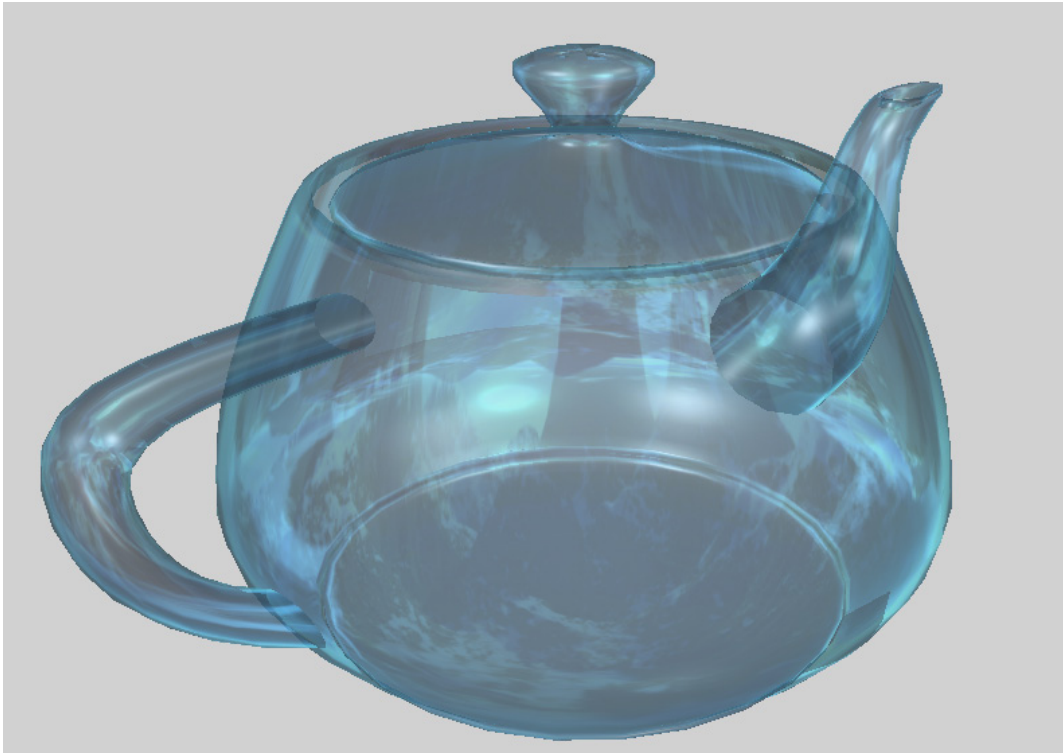


*Without OIT, note the incorrect depth of the seats*

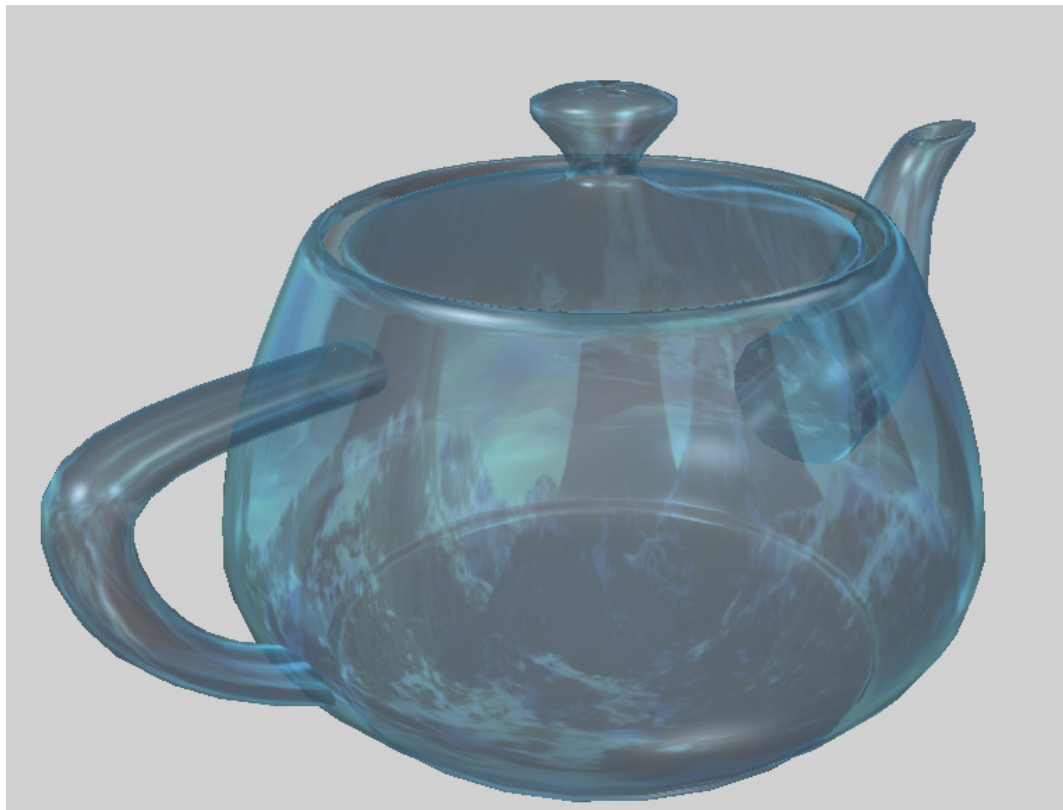


*With OIT applied*

Some new effects that used to be very difficult to render correctly are now being made easy like glass effect with Fresnel for example:



*Without OIT*



*With OIT applied*

## Summary

AMD FirePro professional graphics accelerates transparency rendering in PTC Creo Parametric 2.0 using OIT. AMD Engineers worked closely with PTC Engineers on the order independent transparency support released in Creo Parametric 2.0.

Viewport performance with OIT enabled has been measured to increase up to ten times versus OIT disabled with transparency visual quality dramatically improved with pixel-accurate transparency rendering, solving visual artifact problems and z-ordering issues seen without OIT enabled.

To learn more

Contact your country/regional AMD representative or go to <http://www.amd.com/us/products/workstation/Pages/workstation.aspx>

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