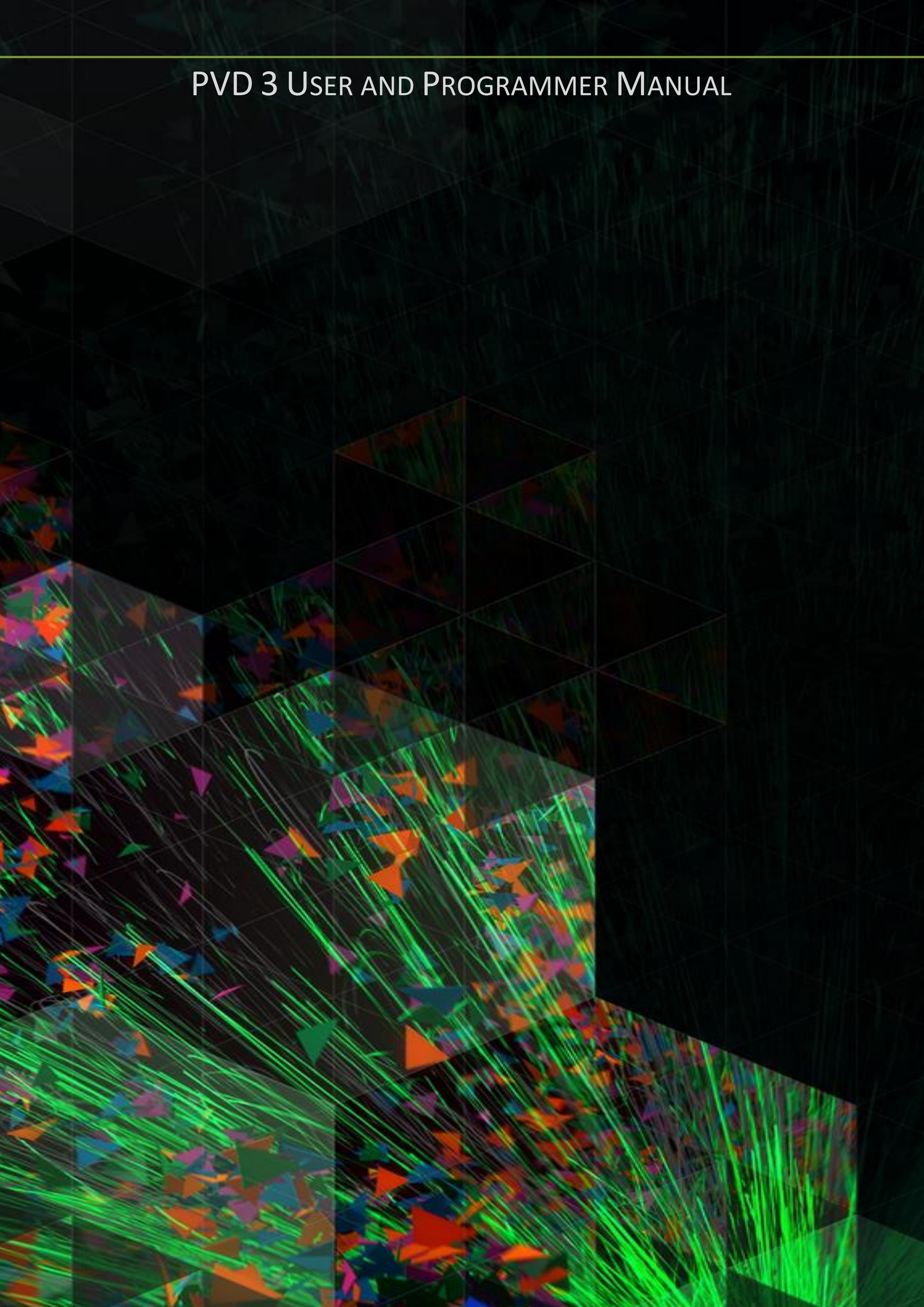
PVD 3 User and Programmer Manual



PVD 3 USER AND PROGRAMMER MANUAL

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Introduction

The PhysX Visual Debugger (PVD) is an object-based database application for analyzing captured data from a remote PhysX simulation session. It can display a set of objects and properties and track the changes to those items over time, "playing" the object graph forward and rewinding it so that developers can analyze the state of the engine and their application frame by frame. The data can be captured and analyzed either in real-time or using a clip that was recorded beforehand. In real-time mode certain functionality is not available because it requires caching of data that is not yet received. At the end of the real-time session, it is possible to save all captured data to a clip.

PVD contains basic database querying capabilities accessed through the main menu, and thus users can graph states of objects over time and in relation to each other. In addition it contains a 3D view of the scene from the PhysX SDK's perspective, allowing quick scene overview and understanding of the engine's current state of the PhysX scene, actors, shapes, queries and all properties of these.

Features

- Scene tree
    - Scene
    - Actors
    - Aggregates
    - Shapes
    - Geometries
    - Queries
    - Joints
    - Clothing (PhysX and APEX)
    - Materials
- Real-time capture
- Debug render
- Profile events
- Memory events
- Error events
- Plotting graphs
- RepX export
- Clip operations

Programmer Interface

Developer interface overview

The connection between PVD and PhysX is instantiated with code in the application layer. PVD integration code within PhysX is enabled in debug, checked and profiling configurations of the PhysX SDK. In order to reduce memory footprint and code size, it is not enabled in release configuration. PVD listens on a TCP socket and awaits a connection request from the application. The default network port is 5435. Sending PVD data through the network stack allows easy connection on any platforms supporting networking.

Connecting to PVD

The examples below demonstrate how to establish a connection with debug rendering, profile events and memory events all enabled. It is important to note that using all of these modes together might slow down the application, particularly if the PhysX scene is rapidly changing. It is good practice to limit the data transfer by enabling only the desired subset of modes. This will reduce pressure on memory and lower the chance of a synchronization spike.

For applications using the PhysX 3.4 SDK:

```
physx::PxPvdTransport* mTransport = physx::PxDefaultPvdSocketTransportCreate("localhost", 5435, 10000);

if(mTransport == NULL)
        return;

physx::PxPvdInstrumentationFlags mPvdFlags = physx::PxPvdInstrumentationFlag::eALL;

physx::PxPvd* mPvd = physx::PxCreatePvd( *mFoundation );
mPvd->connect(*mTransport,mPvdFlags);
```

For applications using the PhysX 3.0-3.3 SDK:

```
PxVisualDebuggerConnectionManager* pvd = mPhysics->getPvdConnectionManager();
if(!pvd)
        return;

PxVisualDebuggerConnectionFlags theConnectionFlags( PxVisualDebuggerConnectionFlag::eDEBUG |
PxVisualDebuggerConnectionFlag::ePROFILE | PxVisualDebuggerConnectionFlag::eMEMORY );

PxVisualDebuggerExt::createConnection(pvd, "localhost", 5435, 10000, theConnectionFlags);
```

Direct clip capture

In some situations it can be beneficial for an application to save PVD data directly to a file that can be loaded later by PVD for inspection and analysis. This is particularly true if network bandwidth is a bottleneck for the application.

For applications using the PhysX 3.4 SDK:

```
physx::PxPvdTransport* mTransport = physx::PxDefaultPvdFileTransportCreate( "c:\\mywork\\sample.pxd2" );
if(mTransport == NULL)
        return;

mPvdFlags = physx::PxPvdInstrumentationFlag::eALL;

mPvd = physx::PxCreatePvd( *mFoundation );
mPvd->connect(*mTransport,mPvdFlags);
```

For applications using the PhysX 3.0-3.3 SDK:

```
PxVisualDebuggerConnectionManager* pvd = mPhysics->getPvdConnectionManager();
if(!pvd)
        return;

PxVisualDebuggerConnectionFlags theConnectionFlags( PxVisualDebuggerConnectionFlag::eDEBUG |
PxVisualDebuggerConnectionFlag::ePROFILE | PxVisualDebuggerConnectionFlag::eMEMORY );

PxVisualDebuggerExt::createConnection(mPhysics->getPvdConnectionManager(), "c:\\temp.pxd2",
theConnectionFlags);
```

ENABLING ADDITIONAL DATA TRANSMISSION

In order to save bandwidth the default behavior is that constraints, contacts and scene queries are not transmitted. It is, however, possible to enable the transmission of these data types.

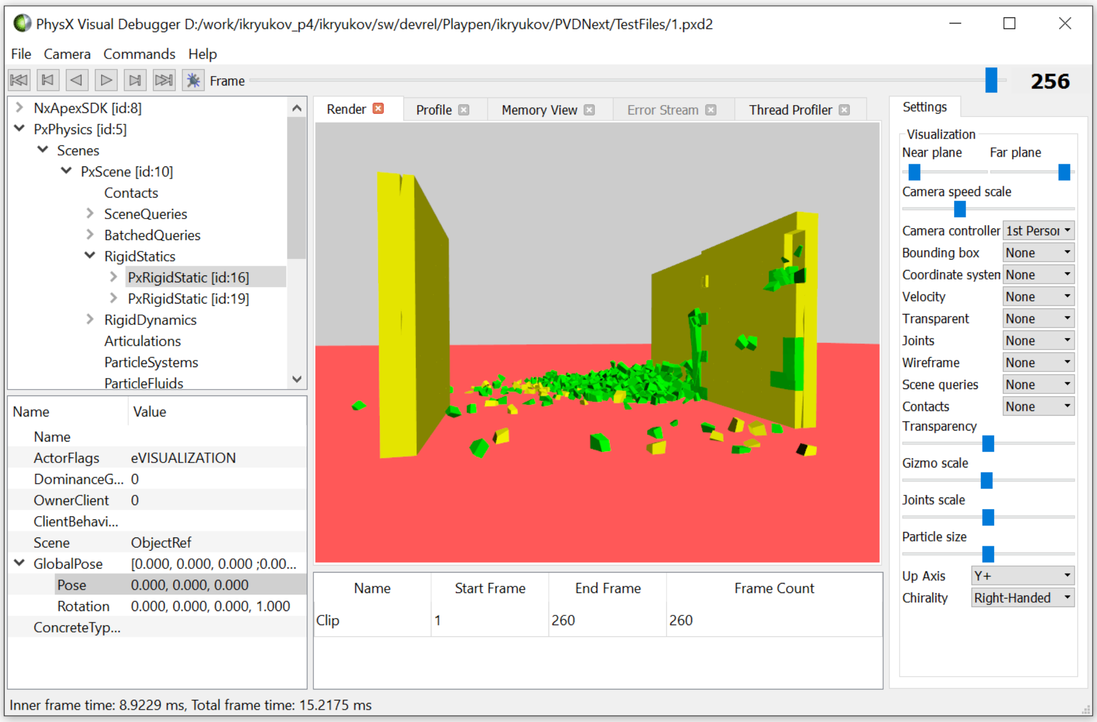
For applications using the PhysX 3.4 SDK:

```
PxPvdSceneClient* pvdClient = mScene->getScenePvdClient();
if(pvdClient)
{
        pvdClient->setScenePvdFlag(PxPvdSceneFlag::eTRANSMIT_CONSTRAINTS, true);
        pvdClient->setScenePvdFlag(PxPvdSceneFlag::eTRANSMIT_CONTACTS, true);
        pvdClient->setScenePvdFlag(PxPvdSceneFlag::eTRANSMIT_SCENEQUERIES, true);
}
```

For application using the PhysX 3.0-3.3 SDKs:

```
mPhysics->getVisualDebugger()->setVisualizeConstraints(true);
mPhysics->getVisualDebugger()->setVisualDebuggerFlag(PxVisualDebuggerFlag::eTRANSMIT_CONTACTS, true);
mPhysics->getVisualDebugger()->setVisualDebuggerFlag(PxVisualDebuggerFlag::eTRANSMIT_SCENEQUERIES,
true);
```

USER INTERFACE



PhysX Visual Debugger D:/work/ikryukov_p4/ikryukov/sw/devrel/Playpen/ikryukov/PVDNext/TestFiles/1.pxd2
File Camera Commands Help
Frame
256
Render
Profile
Memory View
Error Stream
Thread Profiler
Settings

- NxApexSDK [id:8]
- PxPhysics [id:5]
  - Scenes
    - PxScene [id:10]
      - Contacts
      - SceneQueries
      - BatchedQueries
      - RigidStatics
        - PxRigidStatic [id:16]
        - PxRigidStatic [id:19]
      - RigidDynamics
      - Articulations
      - ParticleSystems
      - ParticleFluids

Name	Value
Name	
ActorFlags	eVISUALIZATION
DominanceG...	0
OwnerClient	0
ClientBehavi...	
Scene	ObjectRef
GlobalPose	[0.000, 0.000, 0.000 ;0.00...
Pose	0.000, 0.000, 0.000
Rotation	0.000, 0.000, 0.000, 1.000
ConcreteTyp...	

Name	Start Frame	End Frame	Frame Count
Clip	1	260	260

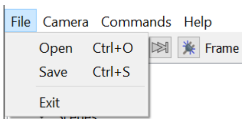
Visualization

Near plane	
Far plane	
Camera speed scale	
Camera controller	1st Persoı
Bounding box	None
Coordinate systen	None
Velocity	None
Transparent	None
Joints	None
Wireframe	None
Scene queries	None
Contacts	None
Transparency	
Gizmo scale	
Joints scale	
Particle size	
Up Axis	Y+
Chirality	Right-Handed

Inner frame time: 8.9229 ms, Total frame time: 15.2175 ms

The PVD application uses a single window to display everything. Conceptually it consists of four parts – scene tree/inspector (left), tabbed event viewer (center), settings (right) and clip transport (top). The event viewer displays debug render information, profile events, memory event and error messages coming from the PhysX/APEX SDKs. Each PVD instance works with exactly one clip/real-time capture at a time. It is not possible to run a real-time capture and review another clip at the same time using the same PVD instance. It is possible, however, to run multiple instances of PVD and use them independently. It is also possible to capture two or more scenes simultaneously provided that each PVD instance uses a different listening port. The listening ports need to be reflected in the application code that connects to PVD.

MENU & TOOLBAR

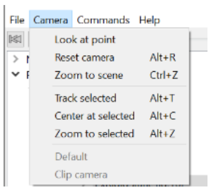


The **File** menu contains commands to open/save clips and to exit application.

Open - open a pxd or pxd2 file, replacing the current scene with the new file.

Save - save the current scene. The old file will be overwritten.

The **Camera** menu contains commands to change the camera settings: It consists of two parts – persistent commands (before splitter) and scene cameras (after splitter).



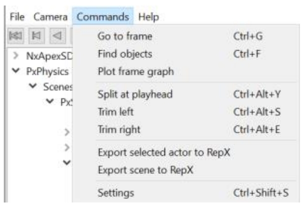
Look at point – calls the dialog asking user to provide three world coordinates (x, y, z) to point the camera to.

Reset camera – resets the camera to point to the center of the scene's bounding box.

Zoom to scene – resets the camera to point to the center of the scene's bounding box, while also moving it in such a way that would allow observing the whole scene at once.

Track selected – automates the camera to follow the currently selected actor. This mode will maintain the relative offset and the selected object. This mode is handy in situations where there are a lot of actors and it is hard to track a particular actor visually.

The **Commands** menu contains commands to help analyze the clip: clip operations, clip navigation, graph plotting, and RepX export.



Go to frame - Sets the current frame to the specified frame number.

Find object by id – points the camera to the actor specified by id.

Plot frame graph – plots a graph depicting frame time along with main PhysX engine phase times (collision, solver).

Split at playhead – splits the current clip in two.

Trim left – remove part of clip to the left of play head.

Trim right – remove part of clip to the right of play head.

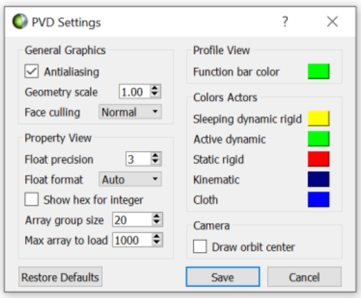
Export selected actor to RepX – exports selected to RepX file

Export current frame to RepX – exports entire frame at play head to RepX file

Settings – PVD UI settings

RepX is a format that allows storing a scene tree along with all of its actors, shapes and properties. The PVD is used “play” captured clips, while RepX is used to simulate starting from state saved in the file. It comes in handy when one needs to reproduce an issue happening in PhysX.

The **Settings** dialog allows changing user interface settings.



General Graphics
- [✓] Antialiasing
- Geometry scale 1.00
- Face culling Normal

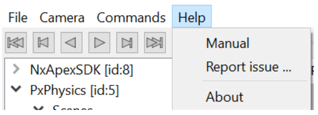
Property View
- Float precision 3
- Float format Auto
- [ ] Show hex for integer
- Array group size 20
- Max array to load 1000

Profile View
- Function bar color 🟩

Colors Actors
- Sleeping dynamic rigid 🟨
- Active dynamic 🟩
- Static rigid 🟥
- Kinematic 🟦
- Cloth 🟦

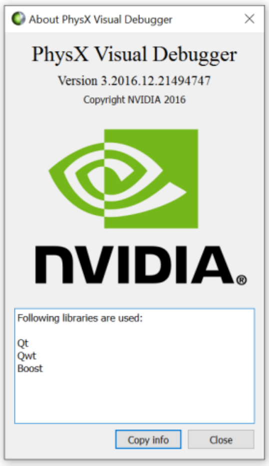
Camera
- [ ] Draw orbit center

The **Help** menu allows the reporting of an issue, reading this manual or calling “About” window.



Report issue… - Opens up system default e-mail application with “To” field filled up.

About – Shows “About” dialog showing the version of the running PVD instance.



PhysX Visual Debugger

Version 3.2016.12.21494747

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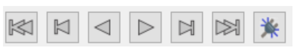
Following libraries are used:

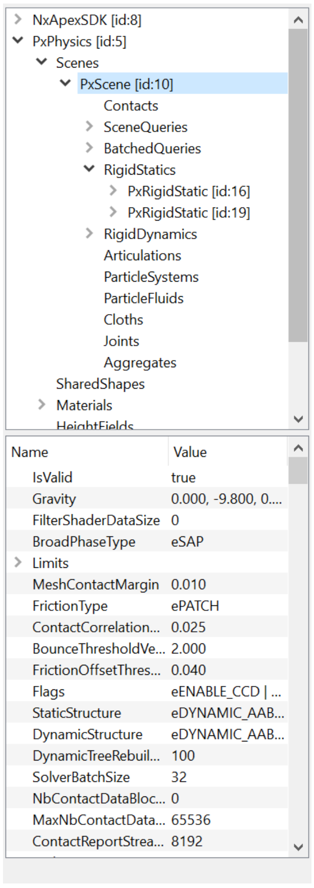
Qt
Qwt
Boost



The toolbar contains buttons which allow navigation of the clip by either stepping one frame back or forward, playing it continuously back and forward or jumping to the clip start/end. The right-most button enables/disables PVD listening on the socket for the incoming connection from the application. Sometimes it might be useful to disable it to review the recorded clip simultaneously with the running game/application that tries to connect to PVD.

SCENE TREE & PROPERTIES INSPECTOR

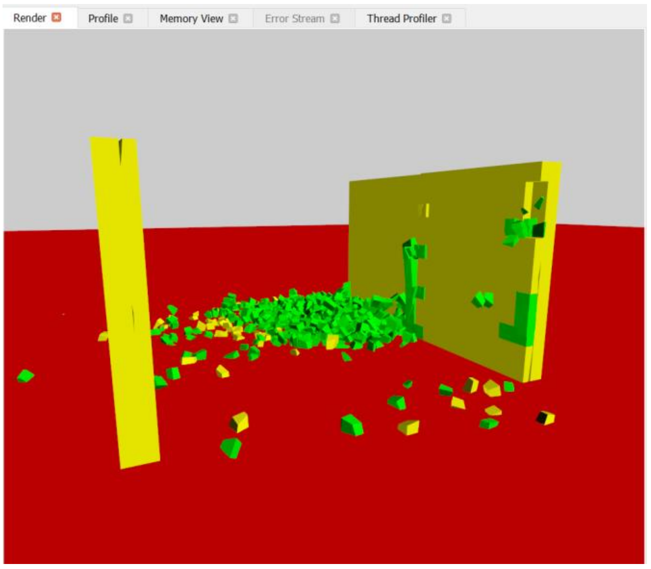
The collections of objects in PhysX and/or APEX are represented in the form of a tree. The top part is the tree itself. The bottom part depicts properties of a selected item in the tree. Properties are unique for each type of entity (scene, actor, shape, query, etc.) and are also specific to the PhysX/APEX SDK version. The property inspector allows the viewing of scalar, vector, matrix, quaternion, enumeration types and arrays of these types. There is an additional special type of property – "ObjectRef". Double-clicking such a property will retarget the currently selected item to the item that the ObjectRef is pointing to. Properties of type "array" have a "+" symbol to the left, which allows expansion of the array. The Property inspector implements the context menu containing commands to copy or plot the value.



```
> NxApexSDK [id:8]
v PxPhysics [id:5]
    v Scenes
        v PxScene [id:10]
              Contacts
            > SceneQueries
            > BatchedQueries
            v RigidStatics
                > PxRigidStatic [id:16]
                > PxRigidStatic [id:19]
            > RigidDynamics
              Articulations
              ParticleSystems
              ParticleFluids
              Cloths
              Joints
              Aggregates
      SharedShapes
    > Materials
```

Name	Value
IsValid	true
Gravity	0.000, -9.800, 0....
FilterShaderDataSize	0
BroadPhaseType	eSAP
> Limits	
MeshContactMargin	0.010
FrictionType	ePATCH
ContactCorrelation...	0.025
BounceThresholdVe...	2.000
FrictionOffsetThres...	0.040
Flags	eENABLE_CCD | ...
StaticStructure	eDYNAMIC_AAB...
DynamicStructure	eDYNAMIC_AAB...
DynamicTreeRebuil...	100
SolverBatchSize	32
NbContactDataBloc...	0
MaxNbContactData...	65536
ContactReportStrea...	8192

Debug Render Tab



The debug render tab displays the world as seen by PhysX. By default there is a free mode camera available. However, if the application provided the PVD SDK with a camera (possibly through other APIs, such as APEX), this camera can also be used. Static rigid actors are marked red; sleeping dynamic rigid bodies are marked orange, active dynamic rigid bodies are marked with varying shades of green and kinematic actors are marked blue. Raycasts are rendered as green lines with a blue vector at the hit point. Overlap scene queries are rendered as green lines. Bounding boxes are rendered white. The center of mass vector is drawn red/green/blue. Velocity vectors are rendered as white arrows. Joints are rendered green. Particle systems are rendered as cyan. Fluid particles are rendered blue.

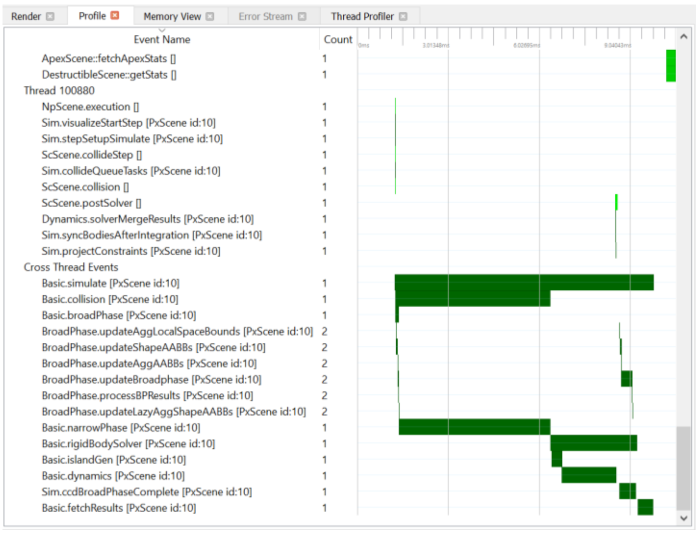
Mouse double left button – select actor

Mouse left button down + mouse move – camera rotation

WASD – move camera forward, strafe left, back, strafe right

Shift + WASD – move camera twice as fast

Profile Events Tab



Event Name	Count
ApexScene::fetchApexStats []	1
DestructibleScene::getStats []	1
Thread 100880	
NpScene.execution []	1
Sim.visualizeStartStep [PxScene id:10]	1
Sim.stepSetupSimulate [PxScene id:10]	1
ScScene.collideStep []	1
Sim.collideQueueTasks [PxScene id:10]	1
ScScene.collision []	1
ScScene.postSolver []	1
Dynamics.solverMergeResults [PxScene id:10]	1
Sim.syncBodiesAfterIntegration [PxScene id:10]	1
Sim.projectConstraints [PxScene id:10]	1
Cross Thread Events	
Basic.simulate [PxScene id:10]	1
Basic.collision [PxScene id:10]	1
Basic.broadPhase [PxScene id:10]	1
BroadPhase.updateAggLocalSpaceBounds [PxScene id:10]	2
BroadPhase.updateShapeAABBs [PxScene id:10]	2
BroadPhase.updateAggAABBs [PxScene id:10]	2
BroadPhase.updateBroadphase [PxScene id:10]	2
BroadPhase.processBPResults [PxScene id:10]	2
BroadPhase.updateLazyAggShapeAABBs [PxScene id:10]	2
Basic.narrowPhase [PxScene id:10]	1
Basic.rigidBodySolver [PxScene id:10]	1
Basic.islandGen [PxScene id:10]	1
Basic.dynamics [PxScene id:10]	1
Sim.ccdBroadPhaseComplete [PxScene id:10]	1
Basic.fetchResults [PxScene id:10]	1

The Profile View displays profile information when clips (newer than 3.0) have such information. The widget provides time (horizontal axis) versus multiple events durations (vertical axis). Since PhysX/APEX can use multiple threads for computation, events coming from those threads are organized in a one-level tree structure, allowing the analysis of each thread individually. Events are rendered as green rectangular bars. The events are originally sorted by event-first occurrence. There is a context menu available for each bar, containing a command to plot the duration of the bar across all frames in the clip.

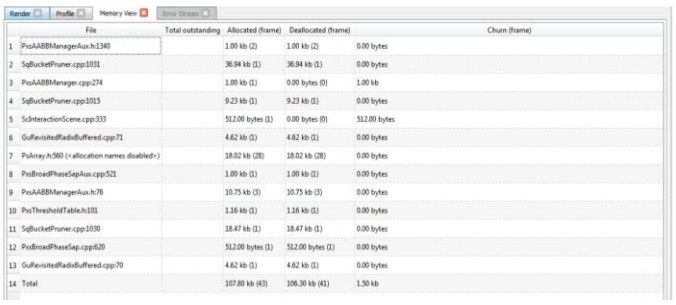
Mouse scroll – scroll the whole windows vertically.

Ctrl + mouse scroll – zoom in/out the time axis.

Shift + mouse scroll – pan left/right the time axis.

Shift + left mouse button – while holding the left mouse button down it’s possible to select a region horizontally with the tool constantly updating duration selected with markers.

Memory Events Tab

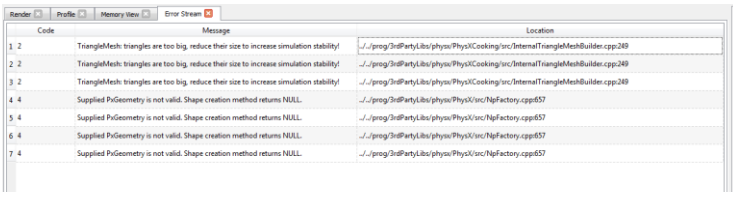


	File	Total outstanding	Allocated (frame)	Deallocated (frame)	Churn (frame)
1	PxsAABBManagerAux.h:1340		1.00 kb (2)	1.00 kb (2)	0.00 bytes
2	SqBucketPruner.cpp:1031		36.94 kb (1)	36.94 kb (1)	0.00 bytes
3	PxsAABBManager.cpp:274		1.00 kb (1)	0.00 bytes (0)	1.00 kb
4	SqBucketPruner.cpp:1015		9.23 kb (1)	9.23 kb (1)	0.00 bytes
5	ScInteractionScene.cpp:333		512.00 bytes (1)	0.00 bytes (0)	512.00 bytes
6	GuRevisitedRadixBuffered.cpp:71		4.62 kb (1)	4.62 kb (1)	0.00 bytes
7	PsArray.h:560 (<allocation names disabled>)		18.02 kb (28)	18.02 kb (28)	0.00 bytes
8	PxsBroadPhaseSapAux.cpp:521		1.00 kb (1)	1.00 kb (1)	0.00 bytes
9	PxsAABBManagerAux.h:76		10.75 kb (3)	10.75 kb (3)	0.00 bytes
10	PxsThresholdTable.h:101		1.16 kb (1)	1.16 kb (1)	0.00 bytes
11	SqBucketPruner.cpp:1030		18.47 kb (1)	18.47 kb (1)	0.00 bytes
12	PxsBroadPhaseSap.cpp:620		512.00 bytes (1)	512.00 bytes (1)	0.00 bytes
13	GuRevisitedRadixBuffered.cpp:70		4.62 kb (1)	4.62 kb (1)	0.00 bytes
14	Total		107.80 kb (43)	106.30 kb (41)	1.50 kb

PhysX/APEX SDKs have an allocation callback, so all allocations and deallocations made by either of these SDKs are logged through the PVD SDK and displayed in the PVD. This widget displays information for each frame individually, so only allocations/deallocations made during the current frame are visible. The “File” column displays the origin of each allocation/deallocation, containing file and line number information. The “Churn” column displays how much memory is allocated but not freed this frame. The “Allocated”/”Deallocated” columns display the amount of memory in human-readable format as well as the count of such events during the current frame.

Error stream tab

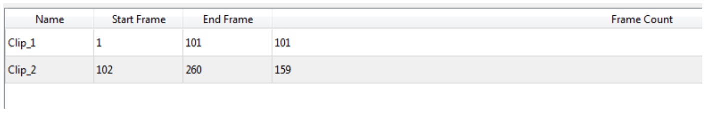
PhysX/APEX SDKs have an error callback, and these warning/error messages are captured by the PVD SDK and thus could be displayed in the PVD. The “Code” column displays an error code according to the PhysX SDK specification. The location column displays the origin of the message, depicting source file name as well as line number.



	Code	Message	Location
1	2	TriangleMesh: triangles are too big, reduce their size to increase simulation stability!	../../prog/3rdPartyLibs/physx/PhysXCooking/src/InternalTriangleMeshBuilder.cpp:249
2	2	TriangleMesh: triangles are too big, reduce their size to increase simulation stability!	../../prog/3rdPartyLibs/physx/PhysXCooking/src/InternalTriangleMeshBuilder.cpp:249
3	2	TriangleMesh: triangles are too big, reduce their size to increase simulation stability!	../../prog/3rdPartyLibs/physx/PhysXCooking/src/InternalTriangleMeshBuilder.cpp:249
4	4	Supplied PxGeometry is not valid. Shape creation method returns NULL.	../../prog/3rdPartyLibs/physx/PhysX/src/NpFactory.cpp:657
5	4	Supplied PxGeometry is not valid. Shape creation method returns NULL.	../../prog/3rdPartyLibs/physx/PhysX/src/NpFactory.cpp:657
6	4	Supplied PxGeometry is not valid. Shape creation method returns NULL.	../../prog/3rdPartyLibs/physx/PhysX/src/NpFactory.cpp:657
7	4	Supplied PxGeometry is not valid. Shape creation method returns NULL.	../../prog/3rdPartyLibs/physx/PhysX/src/NpFactory.cpp:657

Clip operations

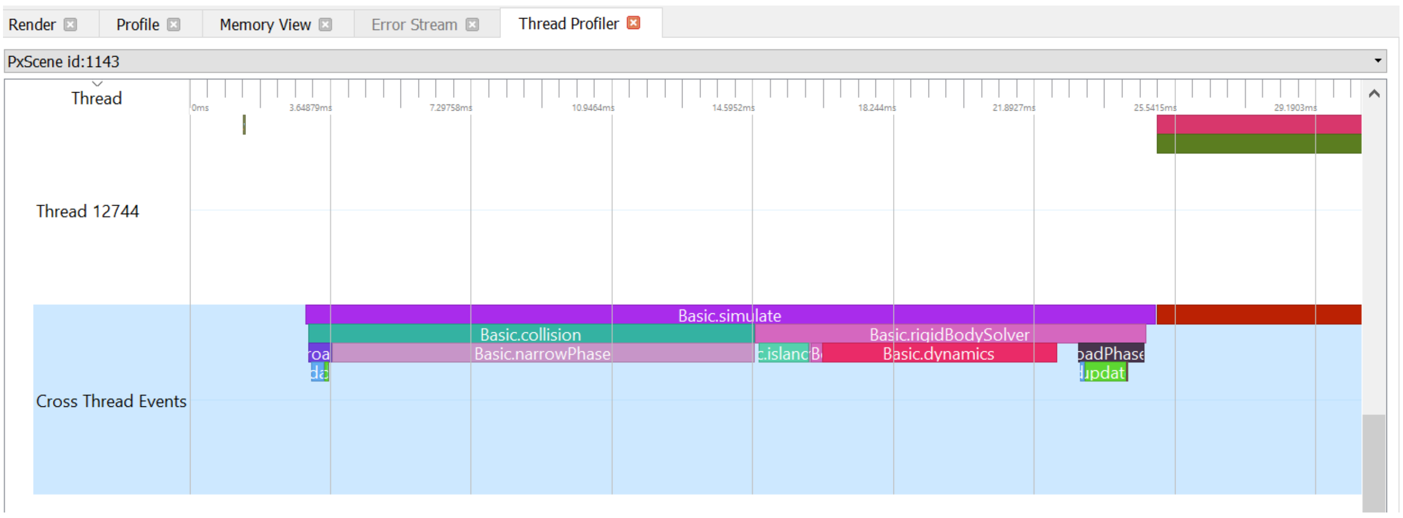
The clip operations widget displays the clips available in the current session. With the “**Split at playhead**”, “**Trim left**”, “**Trim right**” commands from the Commands menu it is possible to cut out arbitrarily sized pieces of a clip. Furthermore, the “**Save as**” and “**Delete**” commands allow the remaining clips to be saved individually to a file or to be deleted. This functionality can be used to isolate a particular point in time and has the effect of reducing clip size (more easily shared).



Name	Start Frame	End Frame	Frame Count
Clip_1	1	101	101
Clip_2	102	260	159

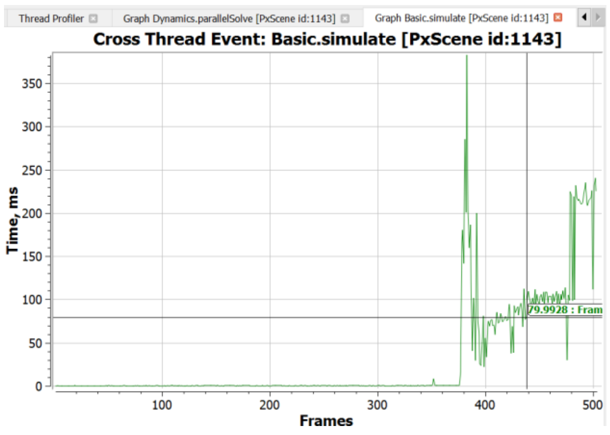
Thread profiler

The Thread profiler displays the same profile information as Profile view, but group events per thread.



Graph window

A fresh graph tab appears each time user each time an event/property is graphed. The horizontal axis corresponds to the frame number, while the vertical axis corresponds to either event duration or property value. Through the context menu the graph can be exported to CSV format for further analysis.



Right mouse button – context menu

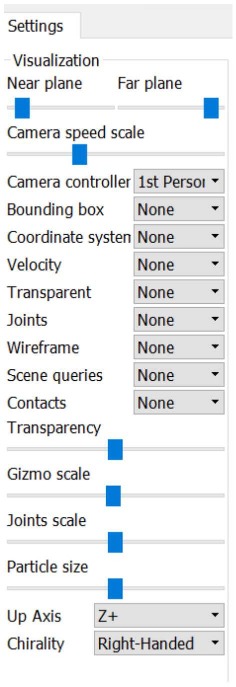
Right mouse button – holding RMB allows selecting a zoom window

Mouse move – allows placing a marker on the graph denoting a Y-value of a point of interest.

Double click – jump to selected frame – X-value.

Mouse scroll – zoom in/out

Settings



Settings

Visualization

Near plane

Far plane

Camera speed scale

Camera controller	1st Persoı
Bounding box	None
Coordinate systen	None
Velocity	None
Transparent	None
Joints	None
Wireframe	None
Scene queries	None
Contacts	None

Transparency

Gizmo scale

Joints scale

Particle size

Up Axis	Z+
Chirality	Right-Handed

The Settings pane controls render debug settings, such as camera speed, near/far planes, and various PhysX debug rendering options.

Near plane – the near plane slider scales to the range 0 – 0.1 cubically (that is, it is not linear, but tends to change the value slower at the beginning).

Far plane – the far plane slider scales to the range 0 – 100000.0 cubically (that is, it is not linear, but tends to change the value slower at the beginning)

Camera speed scale – the camera speed slider scales to range 0-1000000.0 units per frame

Camera controller – choose between First and Third person camera mode

Bounding box – enable/disable bounding box visualization for all, selected or unselected actors.

Coordinate system - enable/disable rendering of local frame (vector triple, red, green, blue arrows) at the center of mass of all, selected or unselected actors.

Velocity – enable/disable rendering of velocity vector (white arrow) for all, selected or unselected actors.

Transparent – enable transparency for all, selected or unselected actors.

Joints – enable/disable joints debug rendering.

Wireframe – enable/disable rendering of all actors using wireframe instead of solid shading.

Scene queries – enable/disable scene queries visualization.

Contacts – enable/disable contacts visualization (need to be enabled separately in the application code).

Transparency – select transparency amount

Gizmo scale – scales arrows (local frame vectors, velocity vectors, etc)

Joints scale – scales joints visualization

Particle size – size particle visualization

Up Axis – allows selecting arbitrary gravity vector (or auto-detect)

Chirality – allows selecting coordinate system chirality

SUPPORTED PLATFORMS

PVD is available on Windows 7, Windows 8.1, Windows 10, Mac OSX Yosemite (10.10) and higher.

To find out which platforms are supported by the PVD SDK please review the PhysX platform support documentation for the version you're using.

CONTACTS

PHYSX SDK SUPPORT WEB PAGE

http://supportcenteronline.com/ics/support/mylogin.asp?splash=1&deptID=1949

PVD WEB PAGE

https://developer.nvidia.com/physx-visual-debugger

REPORT ISSUES TO

mailto:pvdsupport@nvidia.com

CHANGELOG

3.2016.03.20504657: initial release of PVD 3

3.2016.03.20550388: Added particles

3.2016.03.20560874: Added crash reporter

3.2016.03.20579157: Support 4k x 4k HeightField

3.2016.03.20586211: Fixed initial camera position

3.2016.12: Thread profiler, orbit camera