StuntRally
CRYSTAL
HAMMER

Table of contents

Statistics: Code, Releases, Contributors, etc.
History in pictures. Game files.

Components:
Physics, Camera, Input, Graphics, Shadows, Reflections
Game modes, for many and one player.

Road: geometry, editing, errors, track examples, Signs
Weather and Fog, Lighting
Terrain: Heightmap, Layers
Vegetation: Grasses, Trees etc., tracks
Fluids: water, mud

Materials, Simulation
Particles, Sound, Replay, GUI, Effects

Models 3D: objects, vehicles
Translations, TODO (not done), PR

Statistics

Code, C++03

	Lines	Size	Files
Whole repo	86k	4M	464
VDrift	16k	660K	118
2015 2.6*	**37k**	1.6M	167
2013 – 2.0	**24k**	1.1M	112
2011 – 1.2	**11k**	540K	62
2010 – 0.5	**5k**	234K	42

*Only mine, needs to add about +23% from others.
Editor is about 30% (304K + 336K common).

On average cpp is 12 KB - e.g.: 1 header and 3 to 8 cpp.

From VDrift about 50% removed (their rendering with GL) and somewhat edited.

Build 1

CMake (generates project for IDE or makefile)
or my included vcproj.

- Contributors using **IDE**:
  Qt Creator (fast, open, integrated with CMake, Git, etc.)
- Packagers (on Linux) and others: from command line
- Me, still in: (seems to be the fastest)
  Visual Studio 2008 + Visual Assist X + MetalScroll (my fork)

For me the time of full rebuild is:
Editor - 30 sec, Game – 58 s (8 threads), before 2x longer with bullet in code.

Start time is about 5s (empty track, SSD).

Build 2

Comparison how newer Visual Studios utterly fail:
(2x longer compilation, nightmare interface, intellisense tragedy, massive delays):
http://www.yosoygames.com.ar/wp/2013/12/microsoft-we-need-to-talk-about-visual-studio/

Build instructions:

- Linux (4 pages): https://stuntrally.tuxfamily.org/wiki/doku.php?id=compile
- Windows (26 !): https://stuntrally.tuxfamily.org/wiki/doku.php?id=compilevs

On Ubuntu all **dependencies** are installed (by apt-get),
and on Windows many need to be built. *Best all and that takes 1-2 days.*

List: Boost (system, thread, filesystem, wave),
OGRE (with Paging, Terrain, ParticleFX), MyGUI, SDL2,
Bullet, OGG, VorbisFile, OpenALSoft
Few are included our code (*changed):
btOgre*, eNet, OICS*, PagedGeometry*, SDL4Ogre, shiny, TinyXML,2.

I once did VS2010 binaries and don't recommend them.

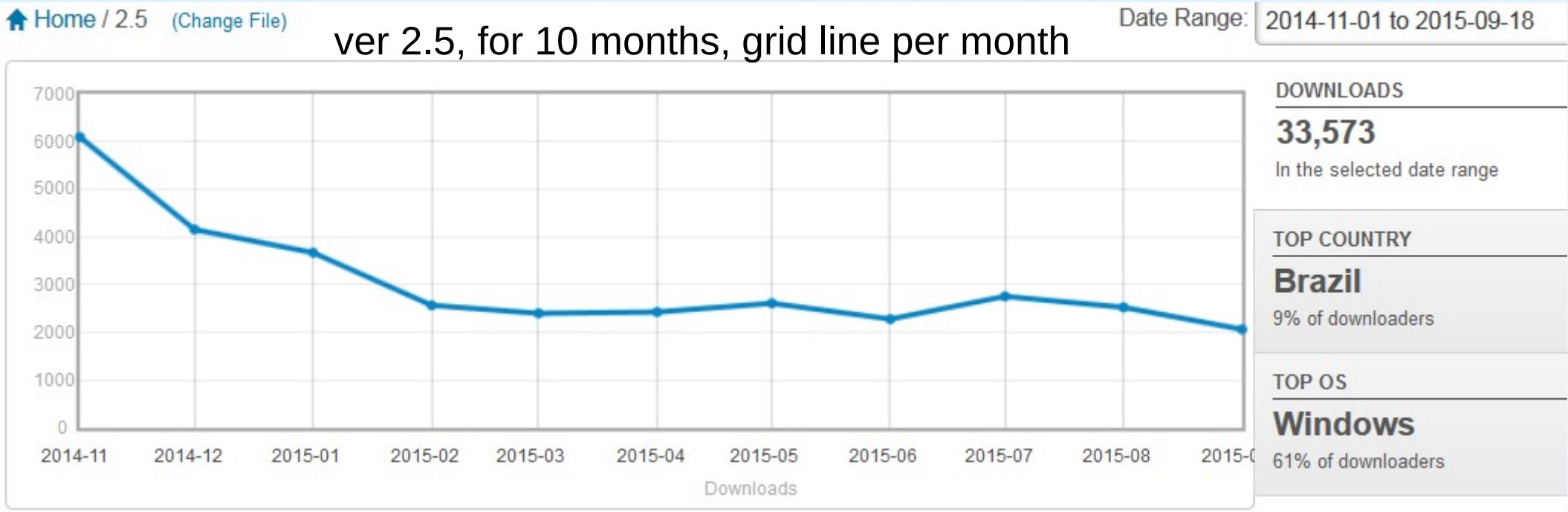
Game has (2.6):

172 tracks,
52 **from contributors**
30%, I finish

25 vehicles - 20 cars,
1 motorbike, 3 spaceships, 1 sphere
16 imported from Blender by me, 1 by *scrawl*
7 from VDrift etc. About 2 have not exact scale.

34 sceneries
main:
Jungle, Desert, Savannah, Forest, Winter, Australia, Island, Greece, Canyon, Autumn, Moss, Volcanic, Toxic, Surreal, Space, Unidentified, Mars, Crystals, Alien

Downloads



ver 2.5, for 10 months, grid line per month

About 3000-2000 monthly – those are only official.

Before above **100 daily,** here 80, today **60.**

Same amount of website visits, about half from from GNU/Linux.

Right after a release more, depends from popularity on other websites.

https://sourceforge.net/projects/stuntrally/files/2.5/stats/timeline?dates=2014-11-01+to+2015-09-18

Release versions

At the beginning all (homepage, wiki, code, releases, issues) on Google Code, limit 200MB (before 1.2)

After a year joined:

Programmers: (**two** since 03-2011, were for a year)
scrawl (DE), *Tapio* (FI), *ahmed* (US)

Releases on SourceForge, latest is 950 MB

Windows, by me installer NSIS

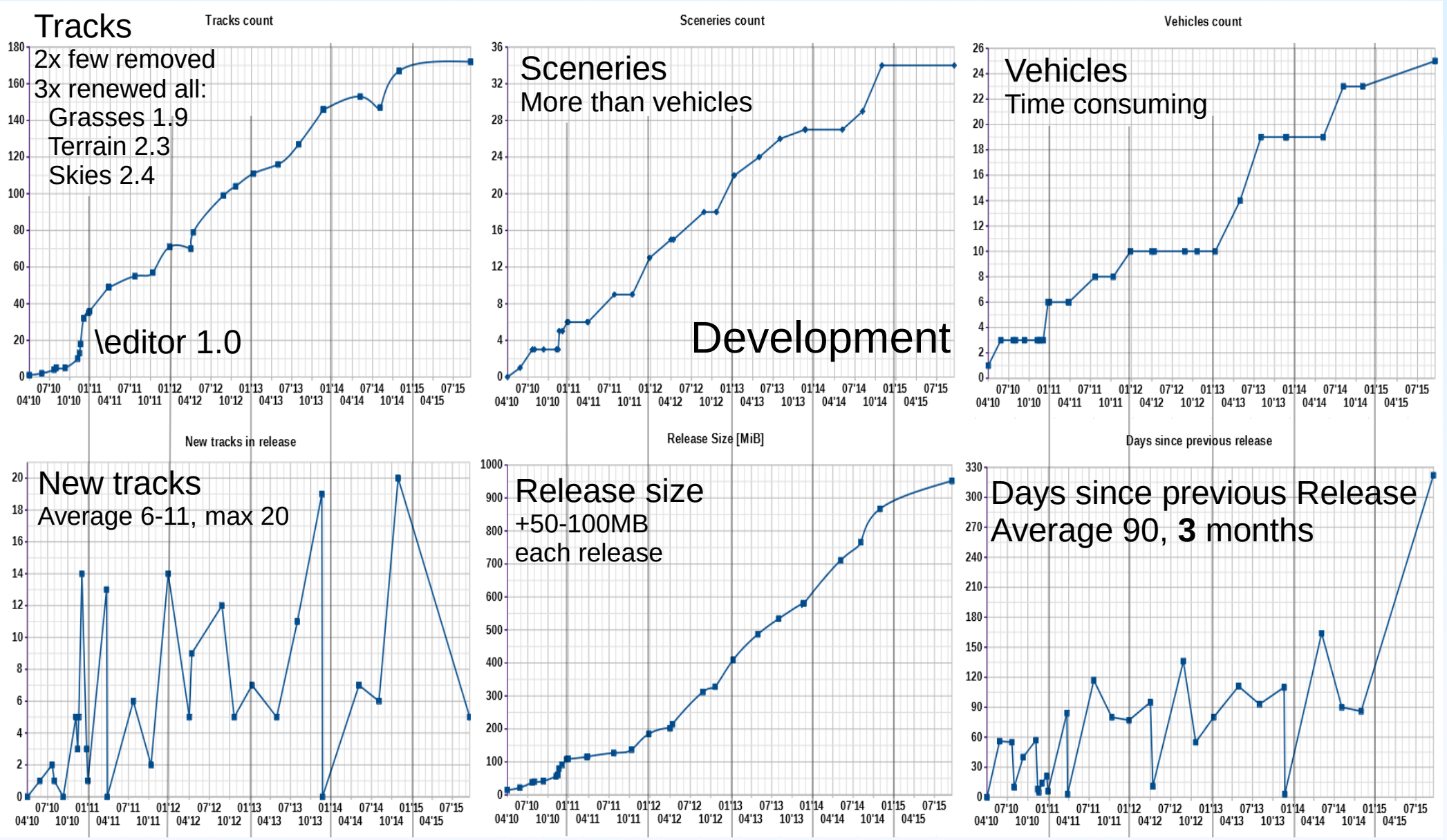
Linux binaries (by *scrawl* on a VM), since 1.1

Repositories Git, on GitHub:

- Code and data (500MB)
- Tracks (1.5 GB), without history about 300 and 500 MB
- Blender files for vehicles, objects and other

https://stuntrally.tuxfamily.org/wiki/doku.php?id=statistics
https://stuntrally.tuxfamily.org/wiki/doku.php?id=changelog

Release	ver	Data
start		12-2009
1st	0.1	04-2010
10 editor	1.0	01-2011
11 Linux	1.1	04-2011
…	every	3 months
25th	2.5	11-2014
last	2.6	09-2015


Tracks
2x few removed
3x renewed all:
Grasses 1.9
Terrain 2.3
Skies 2.4
\editor 1.0
Tracks count
Sceneries
More than vehicles
Sceneries count
Development
Vehicles
Time consuming
Vehicles count
New tracks
Average 6-11, max 20
New tracks in release
Release size
+50-100MB
each release
Release Size [MiB]
Days since previous Release
Average 90, 3 months
Days since previous release
07'10 01'11 07'11 01'12 07'12 01'13 07'13 01'14 07'14 01'15 07'15
04'10 10'10 04'11 10'11 04'12 10'12 04'13 10'13 04'14 10'14 04'15

Contributors (aka the most awesome people)

Google code, shortly Hg, later only for Issues (as my todo).

Git since 03-2011 - 6400 commits, maybe 12 branches,
4500 mine, good week was over 20, and year 1100.

Forum since 11-2012 - late - 266 topics, 1577 posts (on freegamer)

Few people: tracks, testing, suggestions, models, my polls 25 votes, etc.

On **IRC** (chat), max 13 guys, about 6 average, max 4 talking, formerly.

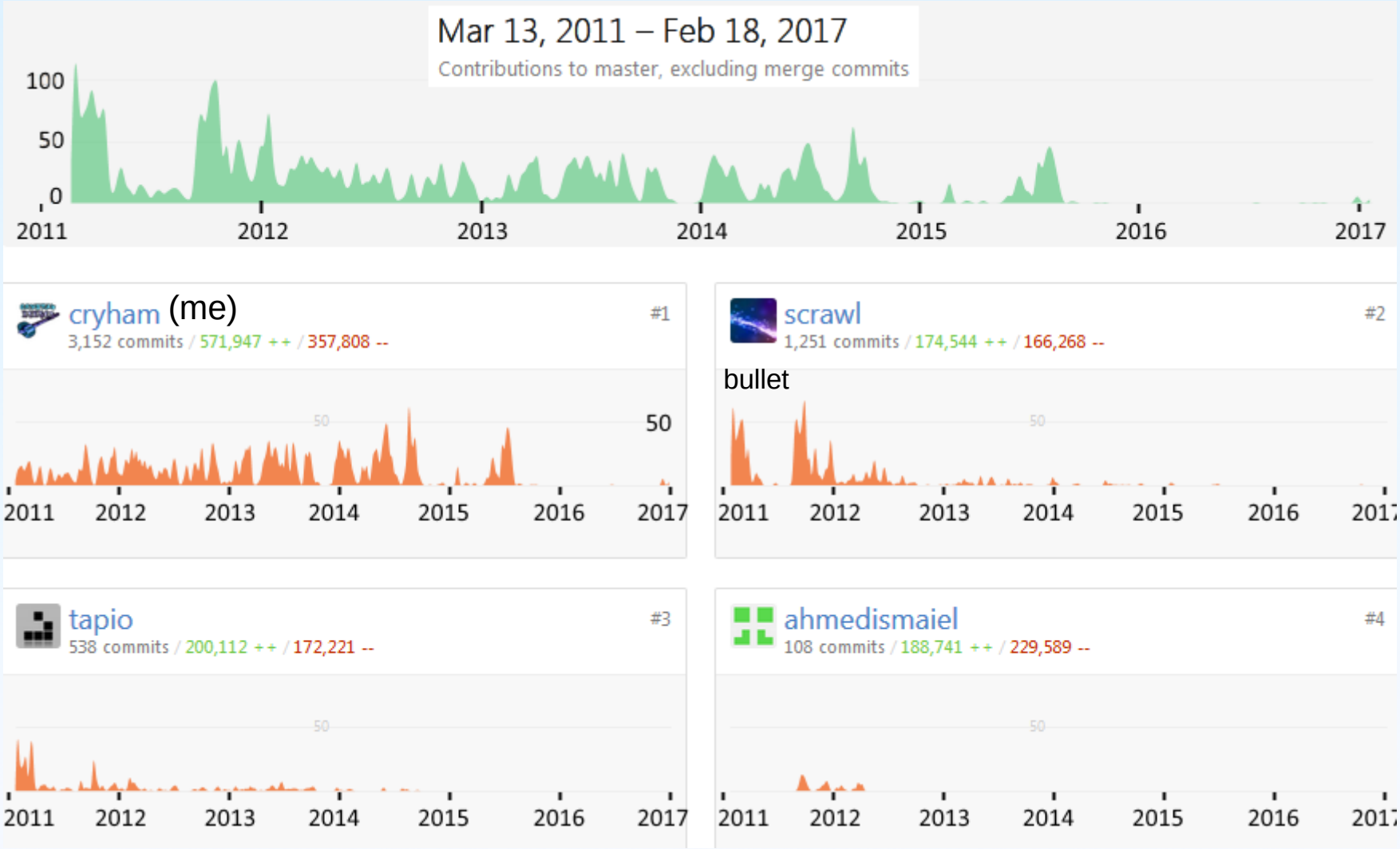
Artists (tracks): rubberduck (DE), Wuzzy (DE), Calinou (FR), etc.

Translations: for 9 languages, with 5 fully.

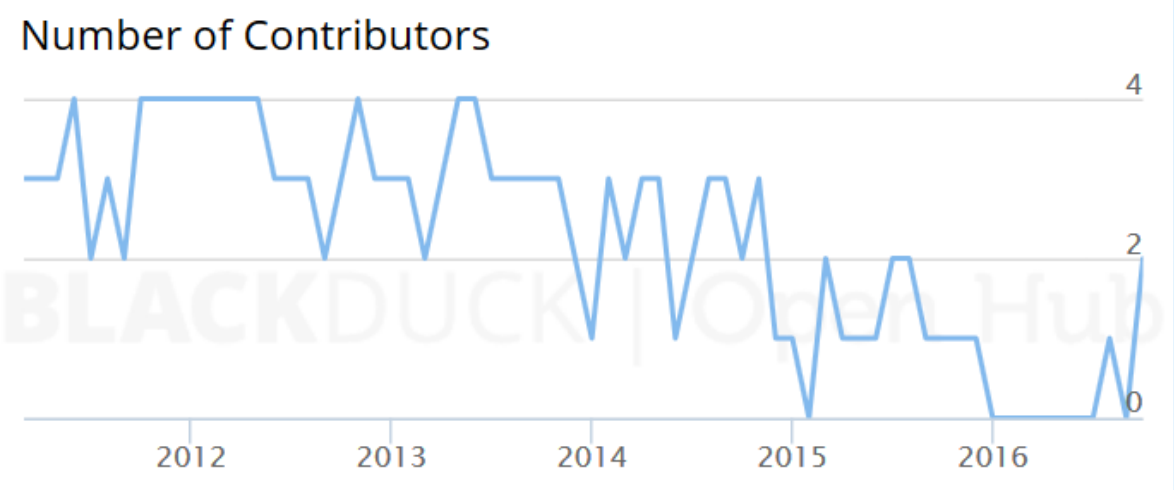
Website since 05-2015 - very late, free, were few tries earlier

Some projects make their website, forum etc. at 1st alpha release.

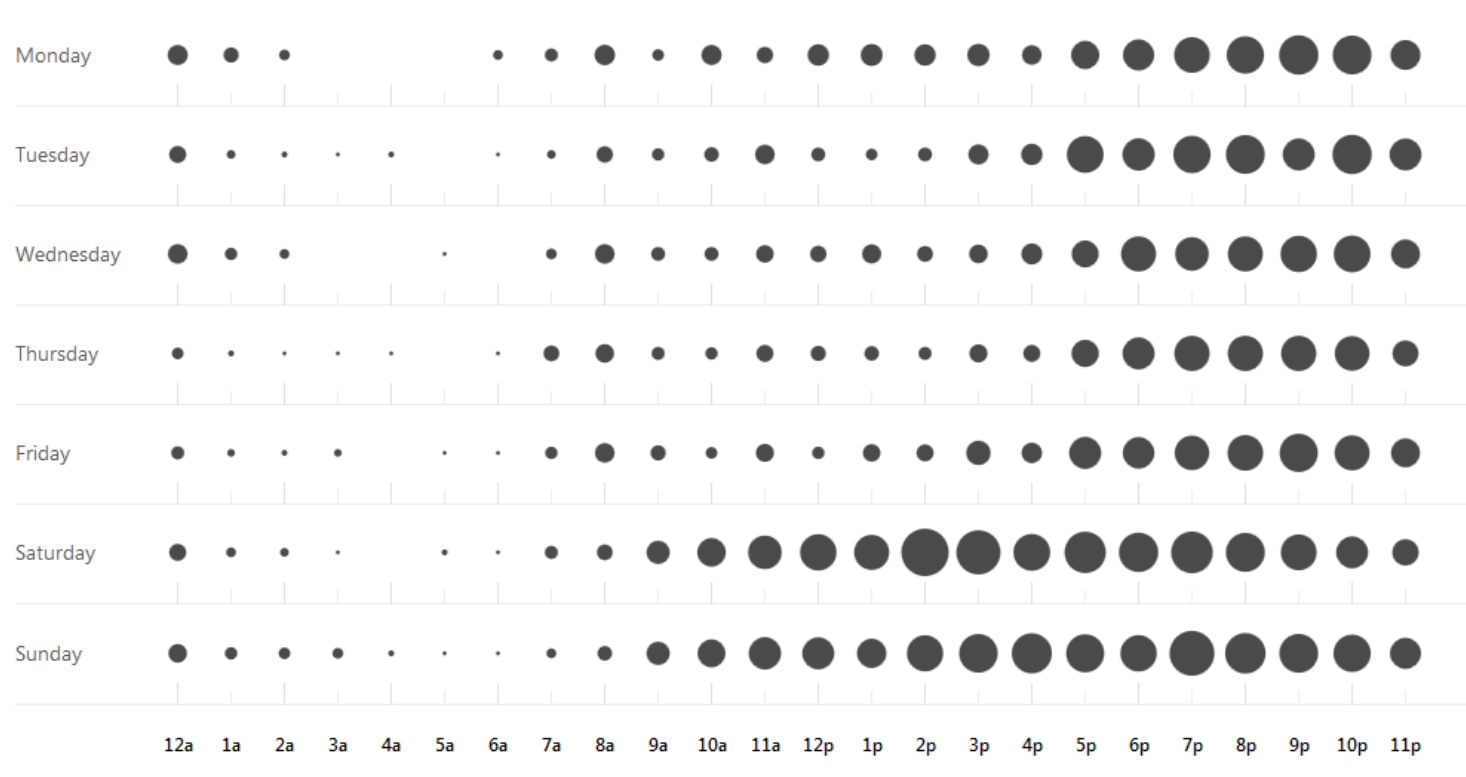
Can be done on GitHub (html+js), SourceForge, etc. With their address in url though.



https://github.com/stuntrally/stuntrally/graphs/contributors

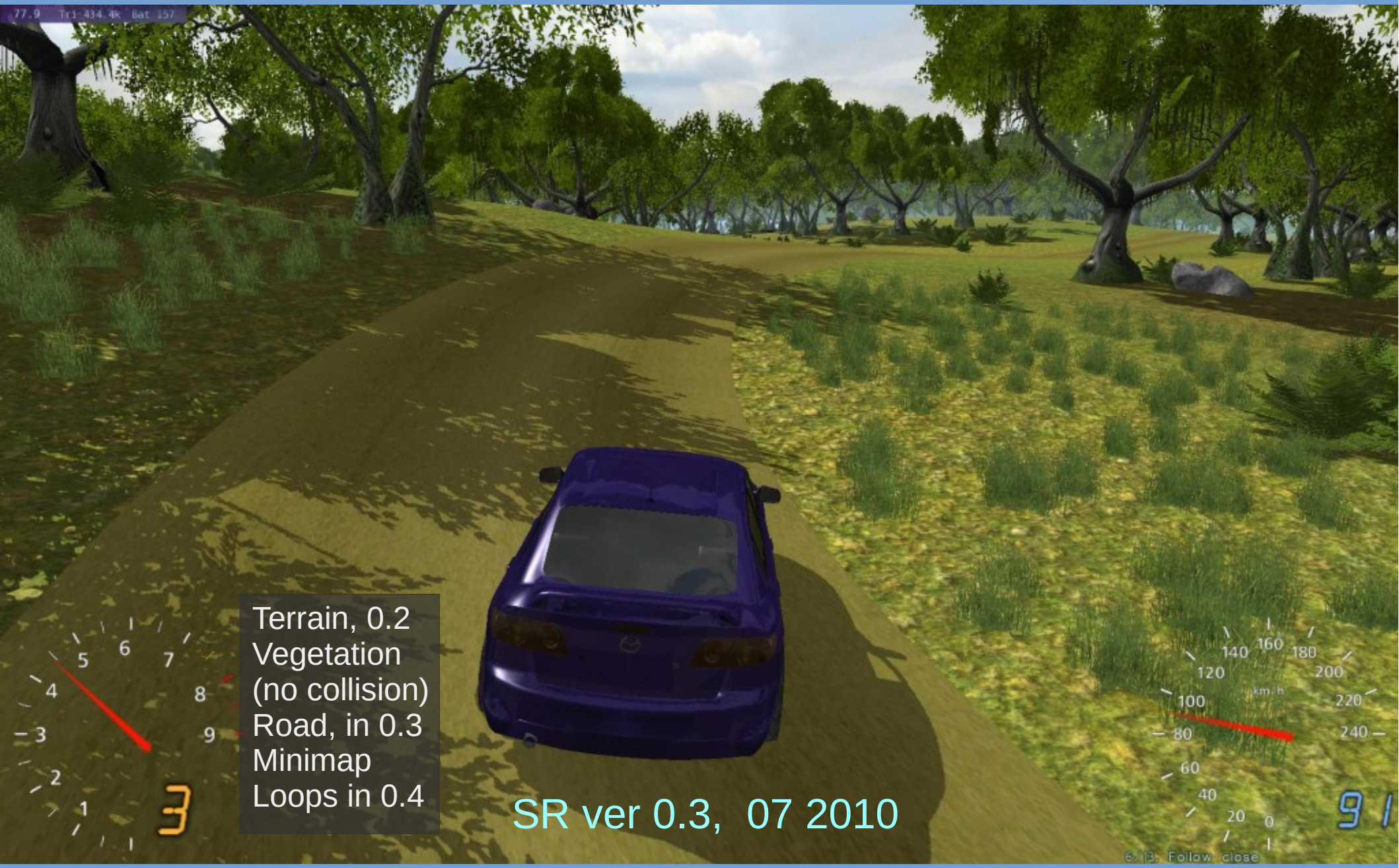


Punch card week days and hours of all commits



Short history of development in pictures

70.6 Tri 78.3k Bat 787
score 362
Time 00:20.330
Last --:--.---
Best --:--.---
Game
Car
Graphics
View
Input
Sound
Car: 3Sasphalt
Track: suzuka2005
360
3Sasp_stiff
3Sasphalt
3Sgravel
3Sice
CT
Change Car
Jungle
Savannah
hungaroring06
suzuka2005
zandvoort
Change Track
Reverse
New Game
VDrift track
2 my tracks
GUI
SR ver 0.2, 06 2010
km/h
6/13. Follow close


Terrain, 0.2
Vegetation
(no collision)
Road, in 0.3
Minimap
Loops in 0.4
SR ver 0.3, 07 2010

70.0 264.5k 235
Time 0:25.806
Last -:--.---
Best 1:04.563
Editor for tracks
Times, records
Road with alpha
Better materials
Pipes 0.7
SR ver 1.0, 01 2011
km/h
7/16 Ext close

Multiplayer
Ghost,
Water, mud
Translations
Input

SR ver 1.6, 04 2012

Time 2:29.81
Last -:--.---
Best 5:03.59
Track 4:40.72
Score 87.8
49% Player1
0% 13m Ghost
gear 3
kph 89
Better water
New grasses
Materials with shiny
Fix simulation params
SR ver 1.9, 01 2013

Time 2:28.74 +16.9
Track 4:19.96
Position 9
Points 5.6
Progress 50%
Terrain textures
Skies _\everywhere
Damage 2.1
Signs, Reverb
Fog in water
Other vehicles
SR ver 2.6, 09 2015
4.4
16 %
2
65
kph

Game files
besides code

Types and size

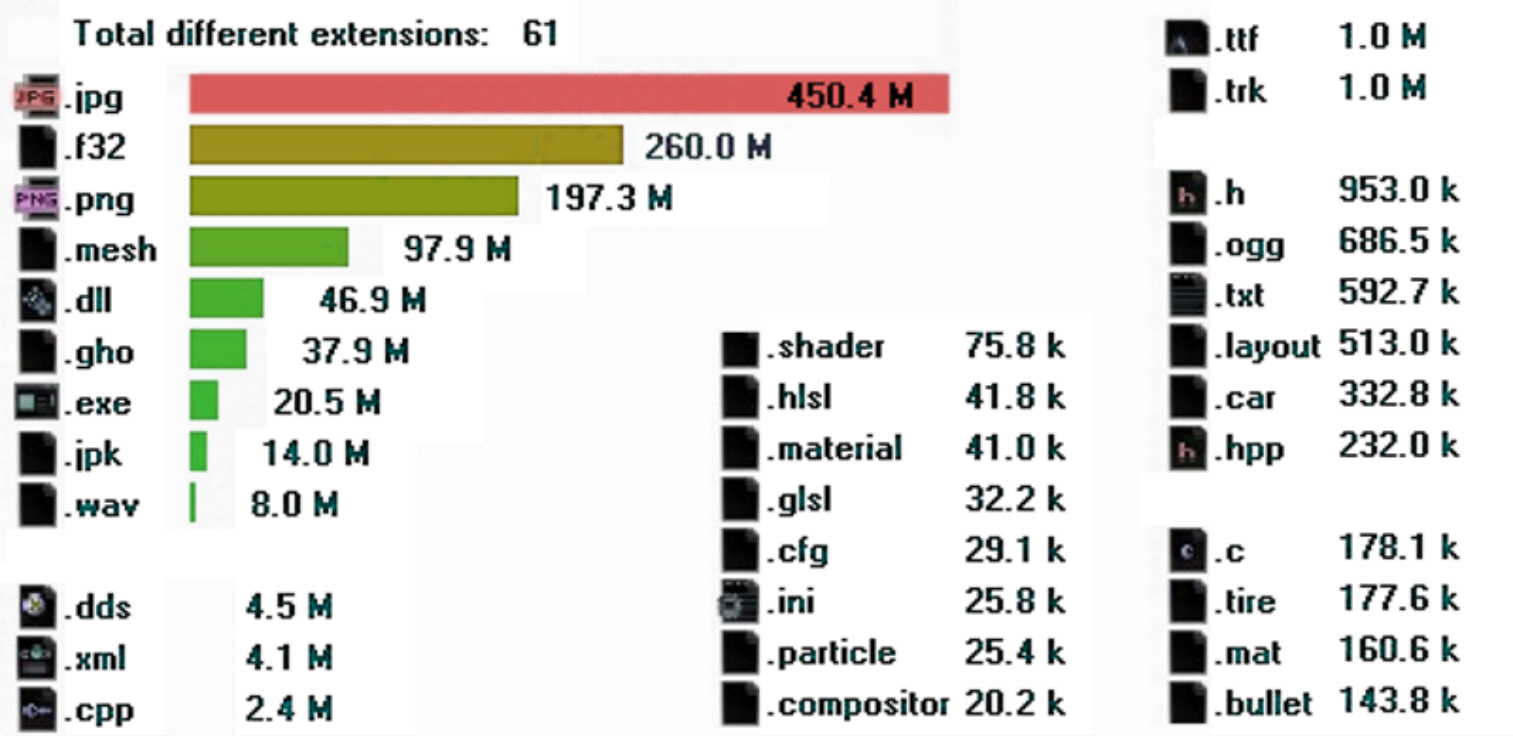
Textures – a lot, for: terrain, grasses, models, etc. [MB]:
.jpg – **472**, .png – **207**, (in it 117 – tracks, from editor)
Height maps for **Terrain** (float) .f32 – **272**,
Models .mesh – **102**, Track ghosts .gho – 49

Track is on average **1.6 M**, big 5, test 0.5

Release
950 M

All,
Unpacked:
1.2 G
4600 files

With git
and build:
3-5 GB



Files 1

Materials and shaders code, for GPU (later)
GUI layout - 2 xml files, GUI editor, often edited by hand, other xml: skin, font

Few ini: (how many entries)

colors (118), tracks (191) - ratings, etc.
surfaces (29) - coefficients for driven surface (bumps, friction)
.car - vehicle setup, susp - suspension factors
tires (3, tire coefficients) - editors (for all underlined) are in game

Inside **user's** dir (a lot):

cfg - ini, settings (from GUI options)
log - OGRE with CPU, GPU info, and a lot of our, load times, etc.
input xml (4 players), progress xml (challenges)..
cars, tracks (subdirs) – if something edited by user, etc.

.png – **1 GB** (final) **cache** of vegetation impostors, and shaders
.rpl – replays and **ghosts** from playing **0..3 GB**

Files 2

Plenty of **XMLs**, read at start (my formats)

collisions (50) - bullet shapes for vegetation, edited in game
fluids (29) - (water, mud), density, damping

challenges (65)
championships (83) - game setup, tracks, requirements

cameras (18), cars (info), reverbs (17) - sound
presets - editor's pick lists (entries) with settings

scene, road – for each track (saved by editor)

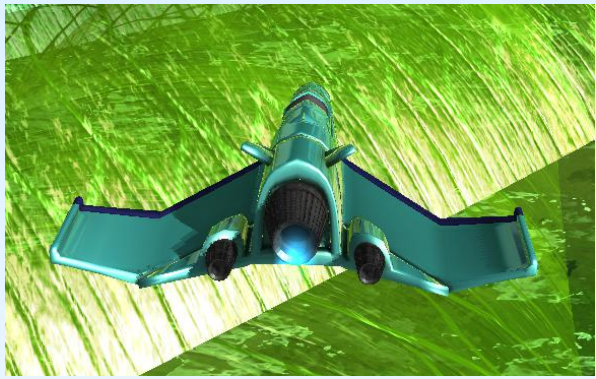
car stats – performance test result of vehicle (done in game)
Straight, speed up and brake (graph, time to 100 km/h, etc.)

Components - list

and *libraries used*

<u>underlined</u> will be later in detail

Physics



<u>Simulation</u> – code from *VDrift* for cars (edited)
Mine for spaceships and sphere

Physics – *bullet*, collisions with:

- Other vehicles (many players)
- Terrain, vegetation - trees have capsules (faster collision and without leaves)
  rocks and buildings mesh (code added later)
- Buoyancy for fluids (open source and mine for mud)
- Editor uses it too

A bunch of vector classes,
2 axes systems x,y,z:
1: OGRE and sound Ogre::Vector3
2: Physics btVector3,
Simulation MATHVECTOR<double,3>
Buoyancy Vec3

Camera

Code started from my previous OGRE project.

5 Types: 1. stiff with vehicle, **2. loosely after (follow)**,
3. stiff after, but loose angle, 4. stiff position, free angle, 5. all free
View, angles, can be changed in game with mouse. Has own options tab.

Connected with physics, **bullet collision**.
(RayCasts from bullet, into scene geometry, vehicles omitted)

- **Casts** 1 ray from vehicle into camera. If terrain happens to be in its way it shortens view **distance** immediately. Later goes back slowly.
- **Casts** 4 rays from above vehicle, down, to get averaged angle of terrain and **tilt** slowly (very needed for 2 and 3).
- Dynamic **sway** (spring simulation): from bumps, sudden hits etc.
- Automatic change **in loops** into type 1 and back.

Components 2

Sound – for long time code from *VDrift (vorbis, ogg)*
Latest version with *OpenAL Soft* (because it has reverb)

GUI – *MyGUI*, is for OGRE, Direct3D, OpenGL
Has editor, many controls, translations

We use Boost: filesystem, threads, system i wave (shiny, materials).
To have one system code for GNU/Linux and Windows.

Multiplayer – *eNet* + *Tapio created*, *using p2p*
Game modes (later).

Particle System and **Effects** (post-process) from *OGRE*.

Input

Keyboard, steering wheel, gamepad, joystick.
Before 2.1: OIS i OISB, worse, less devices, issues.

SDL2 works very good, many platforms, devices.

OICS used for saving parameters and bindings of keys, axes etc.
For keyboard there is sensitivity (speed).

There is no automatic.
Binding has to be done by hand for axes and buttons.
If there are few devices used, only switching input xml files helps.
Same for changing all for other player.

Screen with configuration on next slide.
Bars show value.

Player 1 | 2 | 3 | 4 | Main | General | Shortcuts

Action	Binding	Value	Edit
Throttle	Keypad 8		>
Brake	Keypad 2		>
Steering	Keypad 4 , Keypad 6		>
Handbrake	Space		>
Boost	Left Ctrl		>
Flip	Q , W		>
Rewind (time)	Keypad 0		
Next Camera	C		
Previous Camera	X		
Shift up	A		
Shift down	S		
Go to last checkp.	0		

Press RMB on button to unbind.

One axis for throttle and brake

Details for

Inverse

Keyboard Emulation

Sensitivity

Set all from preset

Components 3

Graphics: *OGRE* (Direct3D9, OpenGL2) from 2006 :(in 2010 still popular
I knew it and used before with: vegetation, particles, camera (since 2007)

Road: wrote myself, there wasn't any and needed own anyway

Editor: whole code mine. *Not Ogitor, because too slow dev and all.*
Editing track takes about 1h for 1km. 8h or more for complicated tracks.

Terrain: from OGRE, later with my auto Blendmap:
(layer mixing), noise done in shader, faster update, done by GPU.

Vegetation (trees, ferns, rocks, etc.), auto placement
Grasses and Vegetation - *PagedGeometry* (very old, *tried HW Instancing*)

Materials: *shiny* (*scrawl* wrote a new system), shaders 3.0
Before 1.8 we had code for shaders done in cpp, with if's etc.

Components 4

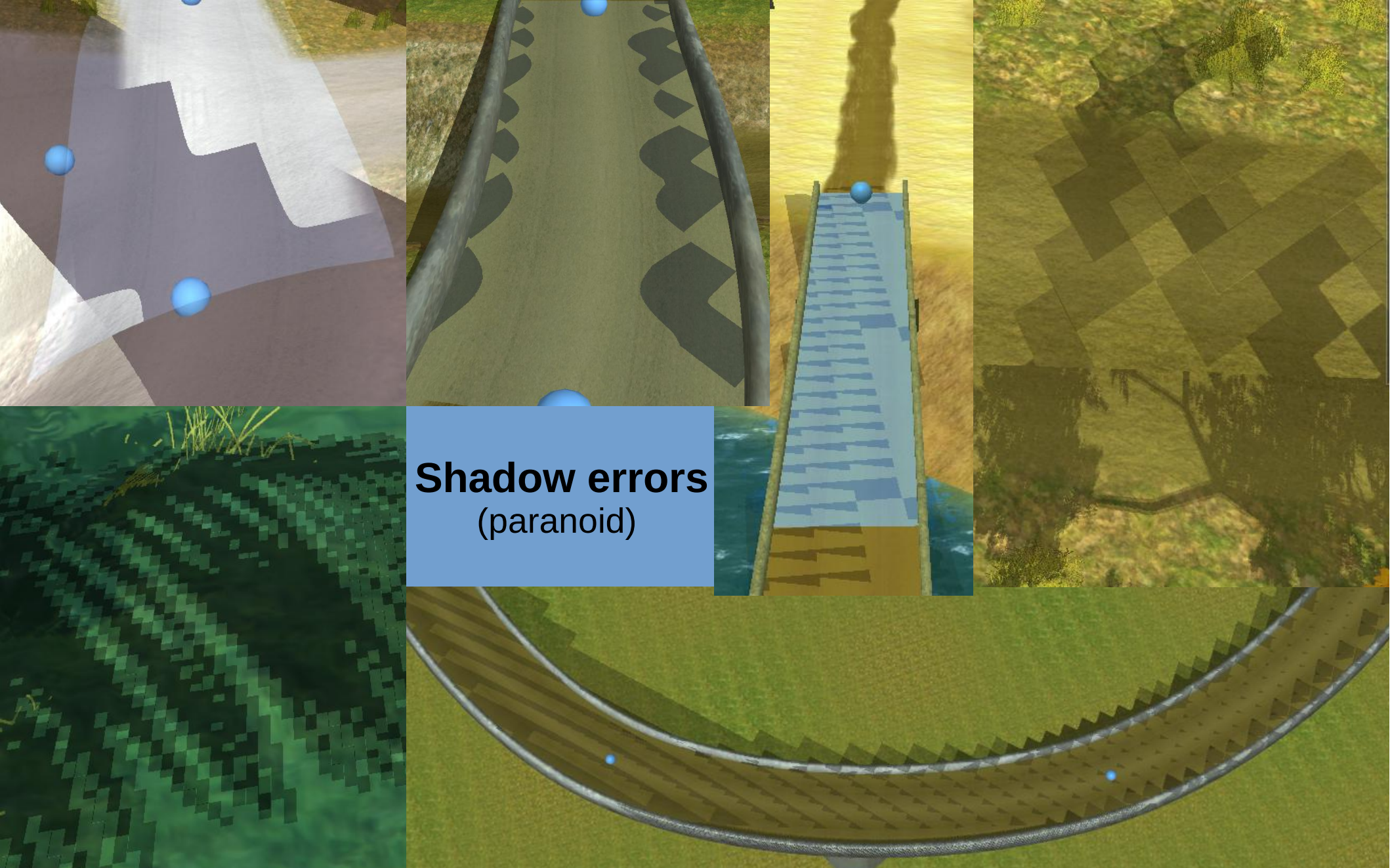
Render To Texture – allows rendering (“drawing”) of 3D scene to texture instead of to screen (and e.g. with different camera).
Later, results can be used as additional sources, during final render to screen.

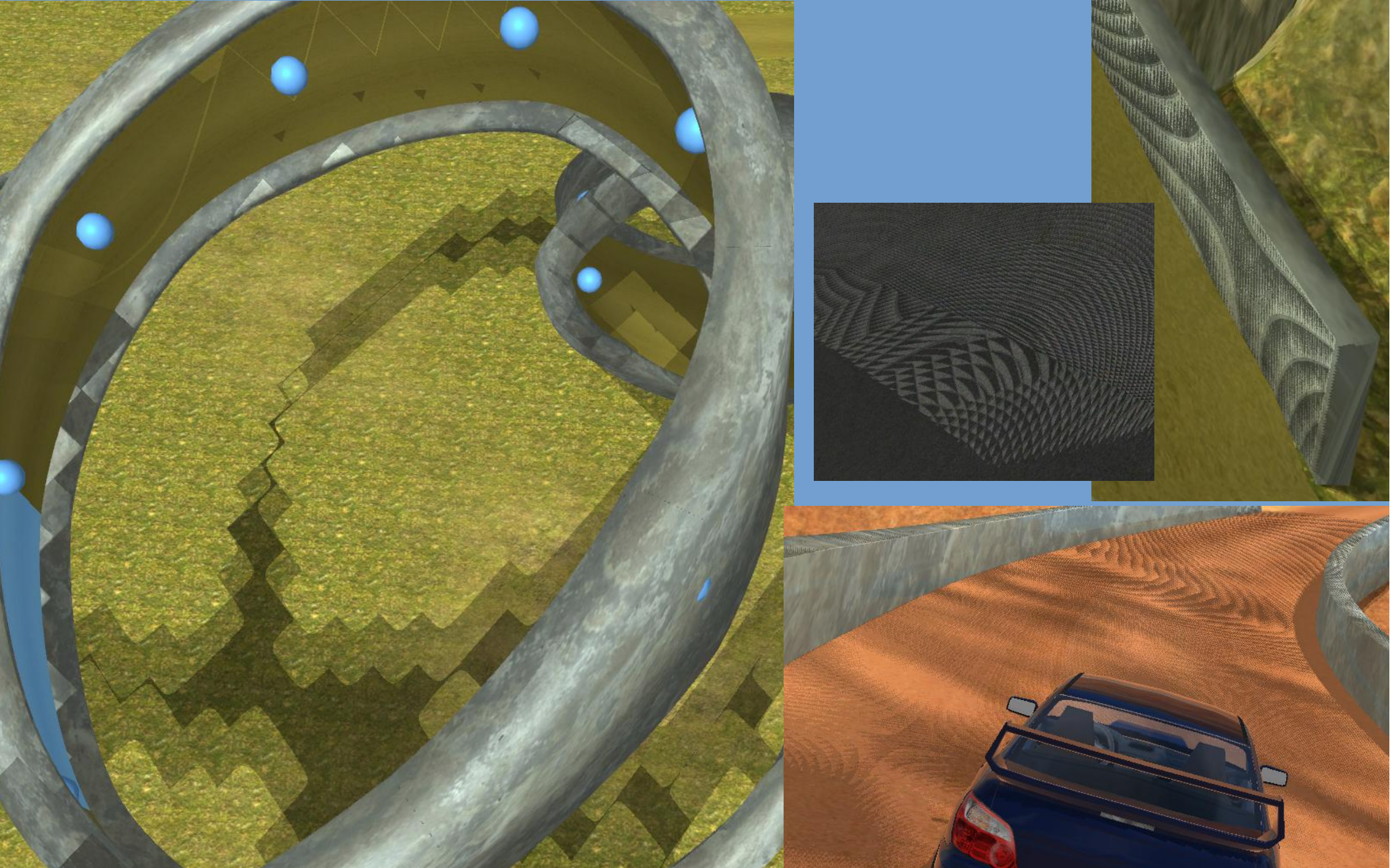
E.g. shadows (float, depth), water, reflections, effects, etc.

Shadows: OGRE, PSSM - Parallel Split Shadowmap, depth,
3 maps: 2k, 1k, 1k, options, about half of framerate because of them!

Each map mean separate render, has to be each frame, OGRE needs CPU.
Errors, from directional lights, square. Shown next..

There are better: CSM, Cascaded. And in new OGRE 2.1.


Shadow errors
(paranoid)



Components 4 continued

<u>Water</u> - is flat, added by *scrawl* in 1.5:

Reflection, Refraction

Size 256 is enough and also blurs, options.

Awesome open source shader adapted since 1.8.

Reflections - Cubemap, 6 textures and cameras.

Size 256, not needed often. Is one each frame.

Render without shadows, fast. Each vehicle has own or common.

So, in total we have already **6** Render To Textures, each frame.

OGRE does its scene transforms, visibility, etc. for each one, on CPU.
Multiplying batches (draw calls). Which need to be low.
This is for 1 player, split screen will multiply it further (depends on options).

Editor has a few own: minimap for road and terrain,

grass density, water depth, blendmap 2D (terrain layer transitions).

Game modes

Split Screen

Split Screen – added by *scrawl*, our code

from 2 to 4 player on 1 screen.
Demanding, decreases Fps (frames per second) a lot,
better to turn off shadows.
Can be played with or without vehicle collisions.

Has **errors:**

- Everyone has from first player:
  - Vegetation impostors (on next slide)
  - Water reflections
- And few from HUD aren't there (arrow, signs)

Replay also plays them.

Split Screen

Vegetation impostors issue >

Rare problem with start places, on tilted road >
For 3,4 players with collisions (maybe 2 tracks)

Start is still set **by hand**
(position, rotation, sizes)
and has to match ground

V

Also road direction and
1st checkpoint

Multiplayer (over internet)

Using *eNet* and written by *Tapio*. Already in 1.5. GUI mine. Developed.

Requires **port** forwarding, not everyone can, 1 player without possible.
Uses **p2p**: each player sends everyone his data over UDP (can be lost).
And GUI uses TCP (needs to arrive).

- Server only for games list in GUI, by *Tapio*, small cpp program.
- There is **chat** in game.
- One can see pings to others.
- Track can be changed (since 2.2, before needed new game).
- No collisions (vehicles go through), or with - but forces aren't sent.
- Physics interpolates (with factor) to received positions.
- Problem with Rewind - one can jump into other vehicle.

Replay also plays them, one can change:
how many views for screen split and camera from other player.

Multiplayer

chat

Multiplayer – after race

30.1 285.4k 201

scrawl finished place: 2

--- 1 Place ---

Lap 3/2
Time 0:06.76
Last 0:43.77
Best 0:42.02

7% CryHam (1)
5% 14m scrawl (2)

scrawl

Multiplayer

Place	Nickname	Time	Best	Lap
1	CryHam	1:25.79	0:42.02	2
2	scrawl	1:29.63	0:36.52	2

13.5 164k 79 152M

Testing, few games started locally

Points

Track's ghost is my drive with ES car,
without errors (I got time rewind). Can be seen in game (green).
It determines track's **time**.

Each vehicle has multiplier for that time. Cars around 0.8 to 1.1.
Fastest spaceship has 1.2. Truck has 0.66.

In game, on each checkpoint, time difference is shown,
(here +0.3) between the expected track's time.

Position 1 and 10 **points** when times are the same.
Division of drive time to track's time computed. And
e.g. for a 3min track it is
1.8s between positions.

Quite good system.
Allows scoring for all
vehicles given one time.

Single player

Single Race - everything available, driving anywhere
for points, or against ghost.

Tutorials – Short series of tracks. Rest like for championships:

Championships – Longer series of tracks, with a theme.

Vehicle can be changed during it.

Requirements aren't difficult, and always the same.

Challenges – Against time. Needs to be driven without mistakes.

Factors can be set for each track in challenge.

Rewards Bronze, Silver or Gold.

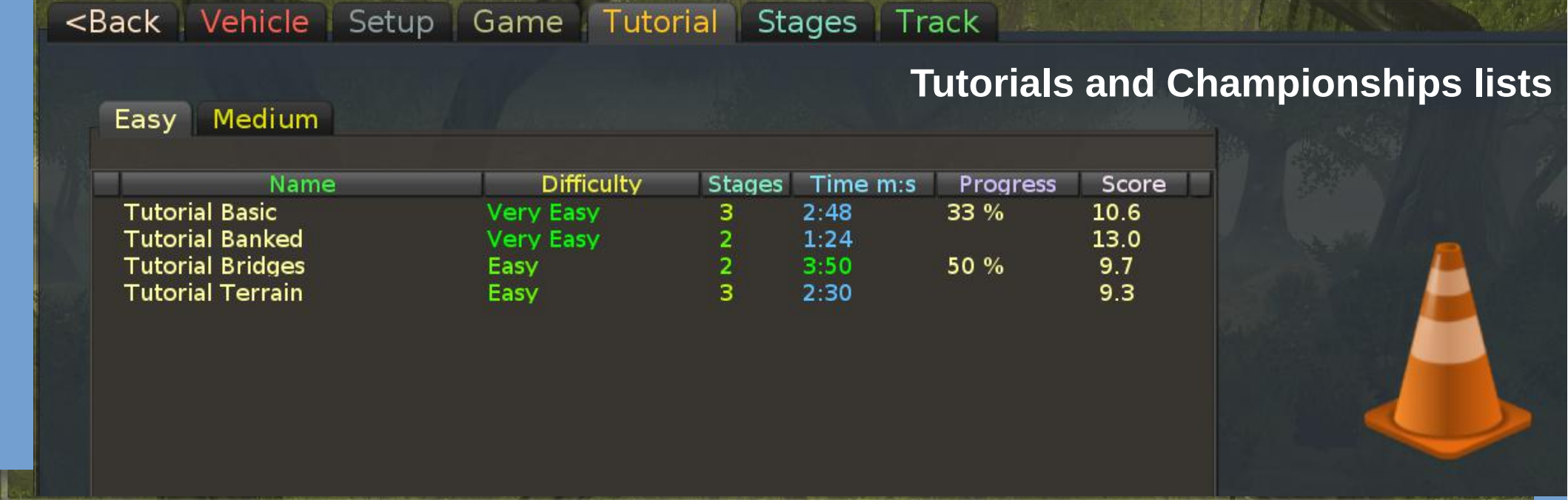
Game is set. Has many options, can allow/deny:

- ✓ Certain vehicles or groups
- ✓ Damage, boost (e.g. each lap), rewind (time), car flip
- ✓ HUD aids:
  arrow, (beam) checkpoint, minimap, ghost, signs etc.

<Back
Track
Vehicle
Setup
Game
Multiplayer
View
Vehicle
Track
Best time 4:35.96 4:13.92
Avg. speed 77 km/h 86 km/h
Points 4.9
Statistics
Length 5.9 km 11.6 m
Area 0.7 km 319 m
77
21' 77'
55
9
6 4 8
1 2 2 1 3 3 3 3 2
Ratings
Name difl * l
Plattorms 4 3 6
Mudflats 4 3 5
Hole 4 2 3
LoopBasic 4 3 2
PipeCrazy 4 3 1
HighMadness 4 4 2
SlowFrenzy 4 2 3
GreenStar 4 5 4
Radioactive 4 4 3
PipeJumps 4 4 5
MtFog 4 3 2
FrozenGarden 4 5 4
Ultima 5 4 9
StuntPark 5 5 5
Snake 5 3 2
TopTwist 5 4 5
MntnTrail 5 3 3
Spider 5 5 8
Web 5 4 9
Infinity 5 4 4
Scorpio 5 4 4
Loops 5 3 2
Pipeline 5 5 7
Crematoria 5 5 9
Freefall 6 4 8
Industrial 6 4 9
BlueHell 6 5 6
Factory 6 5 6
Refinery 6 5 5
DangerRoad 6 2 2
A very tricky, winding, slow track. With 300 m high free-fall part and small alien base. Caution: many obstacles, partly slippery and also on pipe.
Track tab
^sorted by difficulty
Find:
New Game
Reverse
Author(s) rubberduck,CryHam
Minimap

Game settings tab
<Back
Vehicle
Setup
Game
Championship
Stages
Track
Simulation mode (difficulty)
Easy (beginner)
Normal (simulation)
Number of local players
1
1
2
3
4
Number of laps
2
Main
Boost
Damage
Boost
Always
Flip
Always
Damage
Normal
Rewind (time)
Always
Split Vertically
Cars collision
Reverse starting order
Dynamic Objects
Vegetation collision
Road wall full collision

Tutorials and Championships lists



<Back | Vehicle | Setup | Game | Challenge | Stages | Track

Challenges list

Easy | Scenery | Endurance | Chase | Stunts | Extreme | Special | Test

Name	Difficulty	Vehicles	Stages	Time m	Progress	Prize	Score
Sway Roads	Medium	Gravel,Terrain	3	9:29			
Asphalt Cities	Medium	Asphalt,Racing	3	8:04			
Stunt Fun	Medium	Gravel,Racing,T	2	3:15		Silver	11.5
Perfect Jumps	Medium	ES,S1,N1	3	3:30			
Pipe Easy	Medium	Gravel	3	3:43		Gold	15.9
Stunt Long	Hard	XZ,SZ,Y7,360	2	7:55		Silver	10.9
Banked Drive	Medium	S8,TC6,FN	2	2:36		Gold	11.3
Half Pipes	Hard	ES,S1,S8,N1,FN	3	5:31			
Stunt Mix	Hard	Gravel XZ,SZ	2	4:02			
Jump Mania	Very Hard	ES,S1,S8,N1,FN	3	6:19		Gold	12.4
Loop Mania	Very Hard	ES,S1,N1,FN	3	4:18		Bronze	11.9
Pipe Master	Very Hard	ES,S8,UV	2	4:59	50 %		
Stunt Master	Extreme	ES,S1,S8	2	8:50		Gold	11.2
Stunt Madness	Ultra	ES,S1,S8,FN	2	8:08		Gold	13.2
Exhausting stunts	Ultra	ES,S1,S8,FN	2	16:42			

Basic tutorial on simplest tracks. One lap on each track. To learn different road surfaces: gravel, wet gravel, snow.

Start

Reverse

Challenge

Challenge: Winter sleep

Stage: 1 / 4
Track: 0W1-cross

Finished.

Points: 8.6 / 9.0 Didn't pass

Repeating stage.

Back | Continue

Challenge

Challenge: Autumn Forests

Stage: 3 / 5
Track: T2-RedOakPark

Difficulty: Easy
Distance: 1.5 km

Needed
Points: 9.0

Winding road in red autumn forest. With 2 bridges and banked turns.

Back | Start

Challenge

Congratulations !

You have passed this challenge.

Challenge: Winter Chill

Prize: Gold

Points: 11.87 / 11.0 10.0 9.0 Passed

Close

Road

Road

My code. Since the **beginning**, developed a lot. Later less.
Rebuild has about 800 lines of code.
Basing on Catmull-Rom **spline** (interpolated curve), convenient,
has only control points. Gives freedom of road in **3D**.
Automatically generates meshes for graphics and physics (for bullet, collision and i tire contacts). Renders minimap 2D.

Needed for **LODs** (Level of Detail) – decreasing detail (triangle count), the further we see it. Has 4 LODs and some parameters.
Merging of segments to have **less batches** (GPU draw calls).
Generally both are very important optimisations (not only for road).
Without this, Fps would drop. Now it looks good closer to camera.

System started the **editor** - editing road in real-time, also fast creating and changing tracks. Changing 1 point means rebuilding 4 near segments.

Allowed adding checkpoints, **bridges, loops, jumps, pipes** and transitions.
All before version 1.0. Later also materials and their blending.

Road

4 LODs

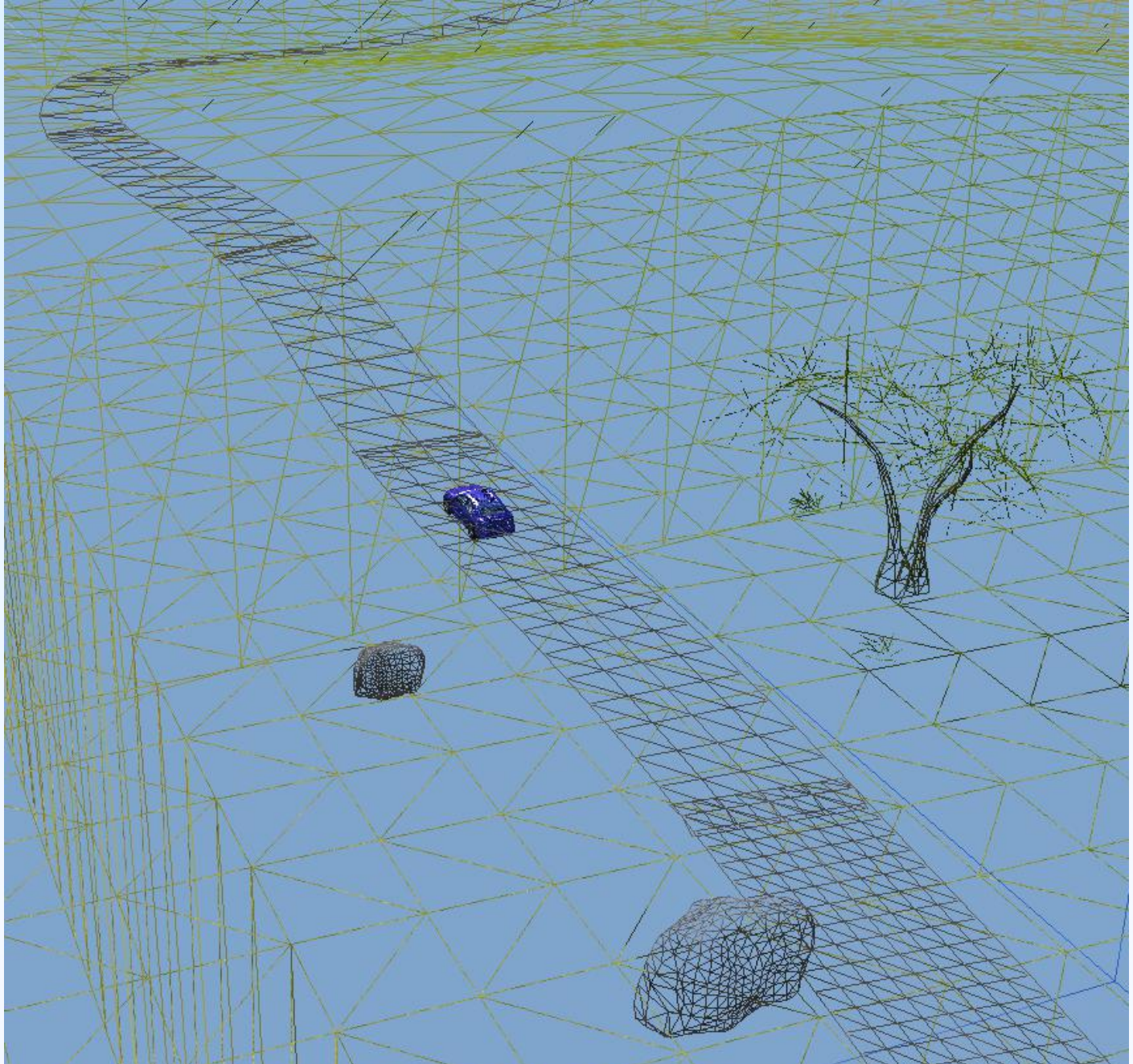
and

Skirt -
Gap patches

Pipes don't have
and can see holes

<u>Always</u>

slightly
above
terrain (6cm)



BTW

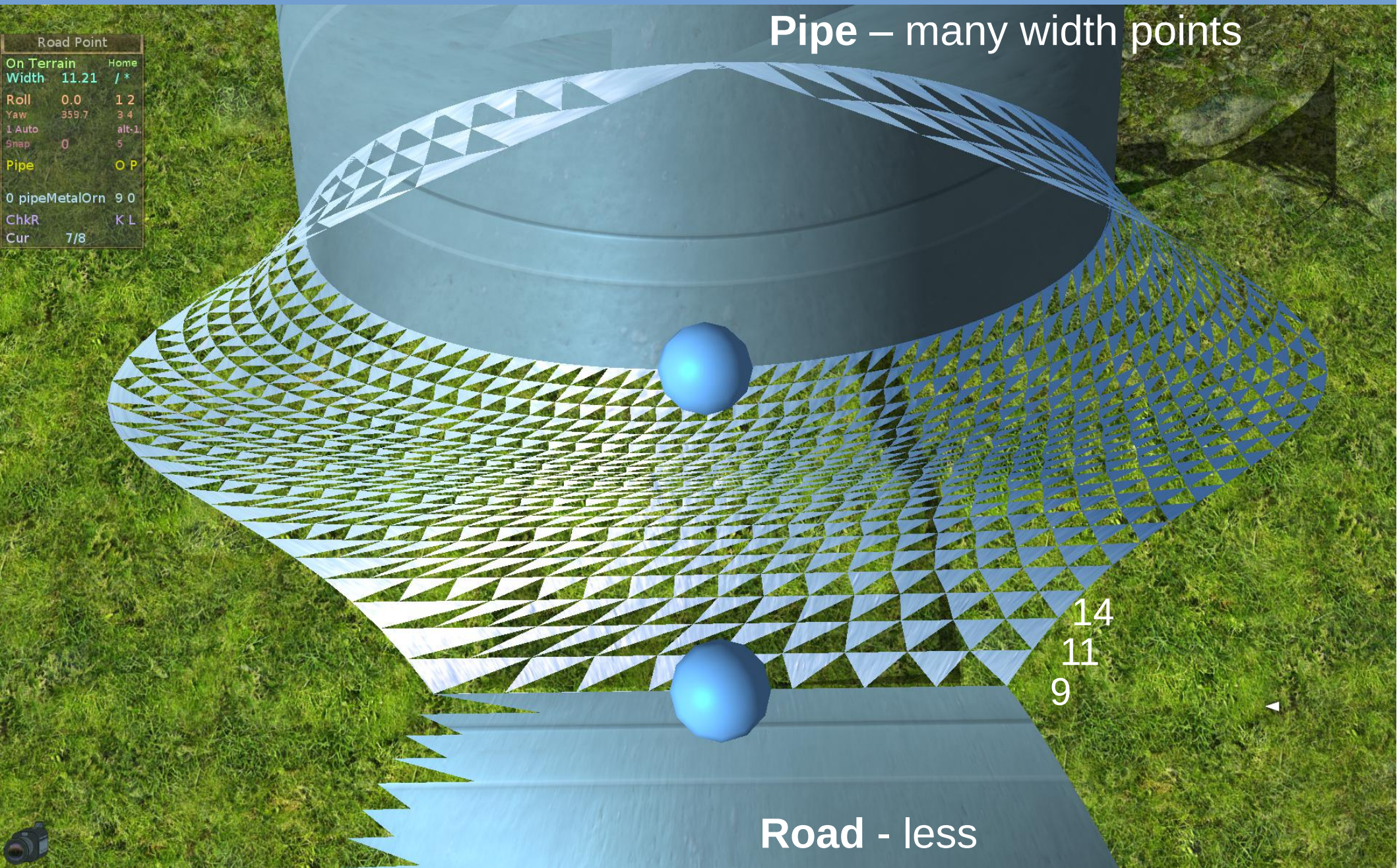
Terrain

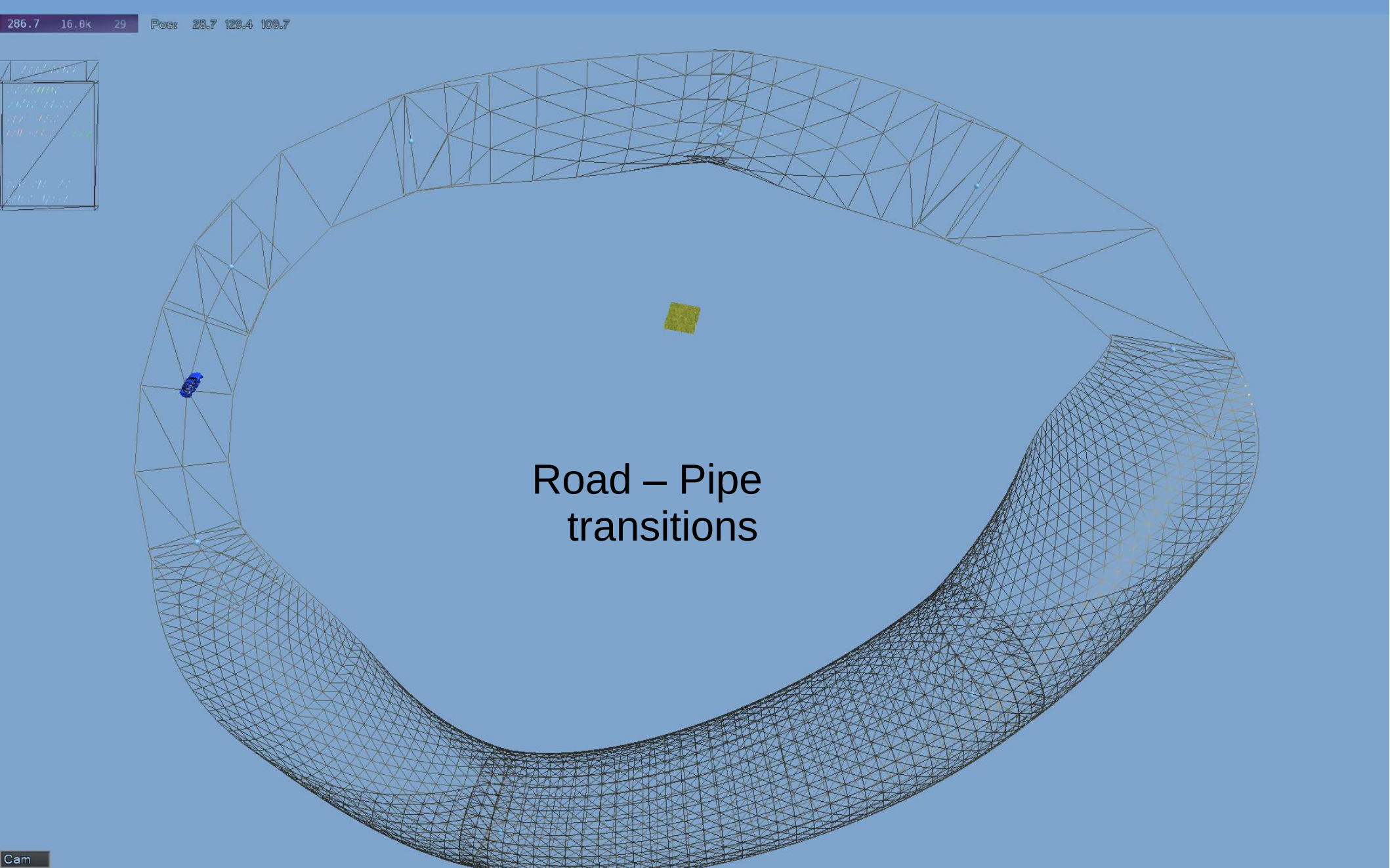
also with
LOD

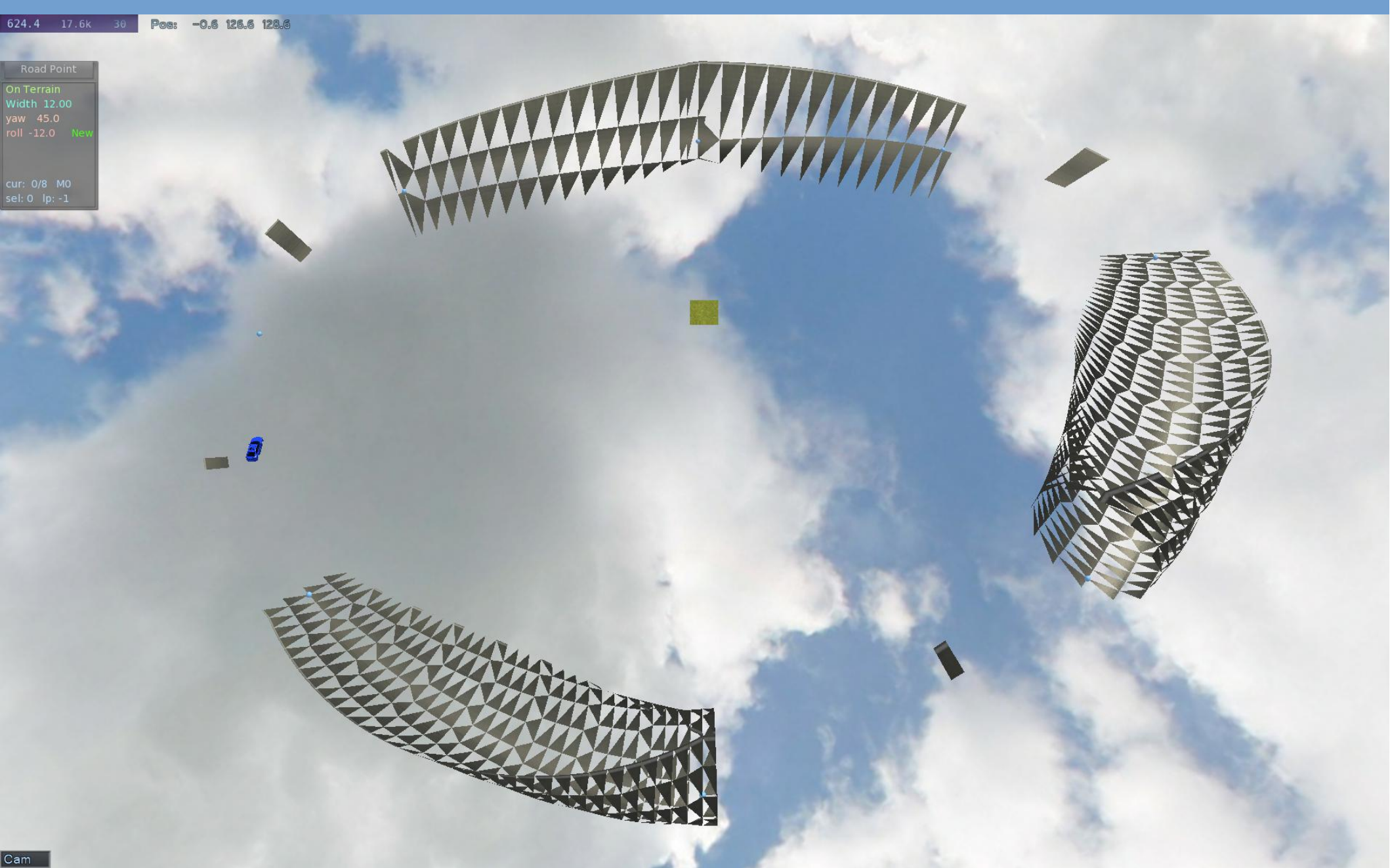
plus geo-
morphing

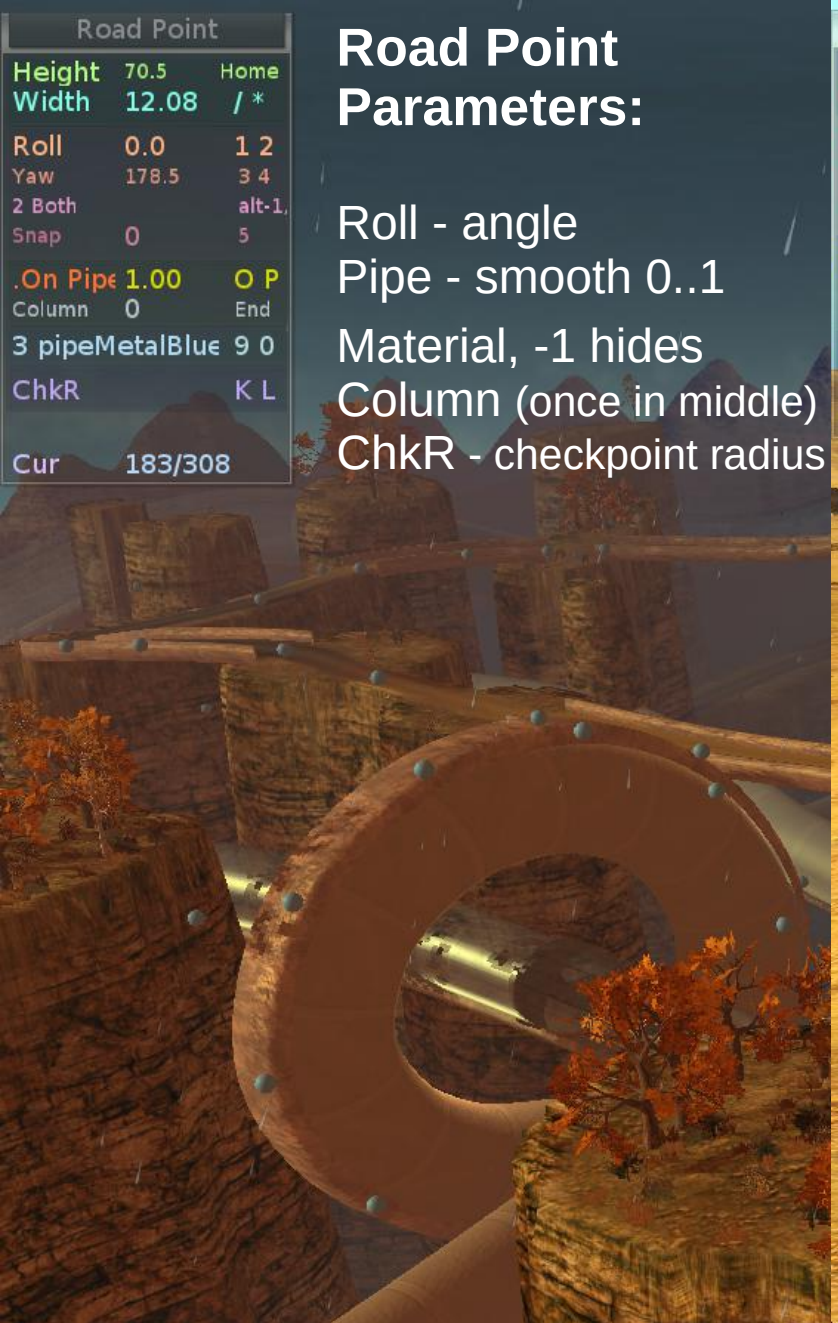
and

Skirt too


Pipe – many width points
Road Point
On Terrain
Home
Width 11.21
/ *
Roll 0.0
1 2
Yaw 359.7
3 4
1 Auto
alt-1
Snap 0
5
Pipe
O P
0 pipeMetalOrn
9 0
ChkR
K L
Cur 7/8
14
11
9
Road - less


286.7 16.0k 29
Pos: 28.7 129.4 109.7
Road – Pipe
transitions
Cam


624.4 17.6k 30
Pos: -0.6 126.6 128.6
Road Point
On Terrain
Width 12.00
yaw 45.0
roll -12.0 New
cur: 0/8 M0
sel: 0 lp: -1
Cam



Road Point Parameters:

Roll - angle
Pipe - smooth 0..1

Material, -1 hides
Column (once in middle)
ChkR - checkpoint radius

Selection: copy, paste,
rotate, scale,
editing many at once, etc.

102.1 341k 106 440M
Time 0:30.33 +0.3
Track 1:56.74
Position 1
Points 11.7
Progress 25%
48 %

105.1 550k 194 547M
Lap 1 / 1
Time 0:57.55 -3.4
Track 4:08.99
Position 1
Points 16.0
Progress 24%
0 %
55

96.4 466k 199 492M
Time 3:29.37 +23.6
Track 4:04.53
Position 7
Points 6.8
Progress 73%
30 %
95

4:06.84 +27.0
5:50.84
6
7.2
62%
In game
41 %
150

40.01093k 559 353M
In editor
Road Point
On Terrain
Home
Width 12.04
/ *
Roll 0.0
1 2
Yaw 149.8
3 4
2 Both
alt-1,
Snap 0
5
Pipe
O P
0 roadSand
9 0
ChkR 2.0
K L
Cur 70/148

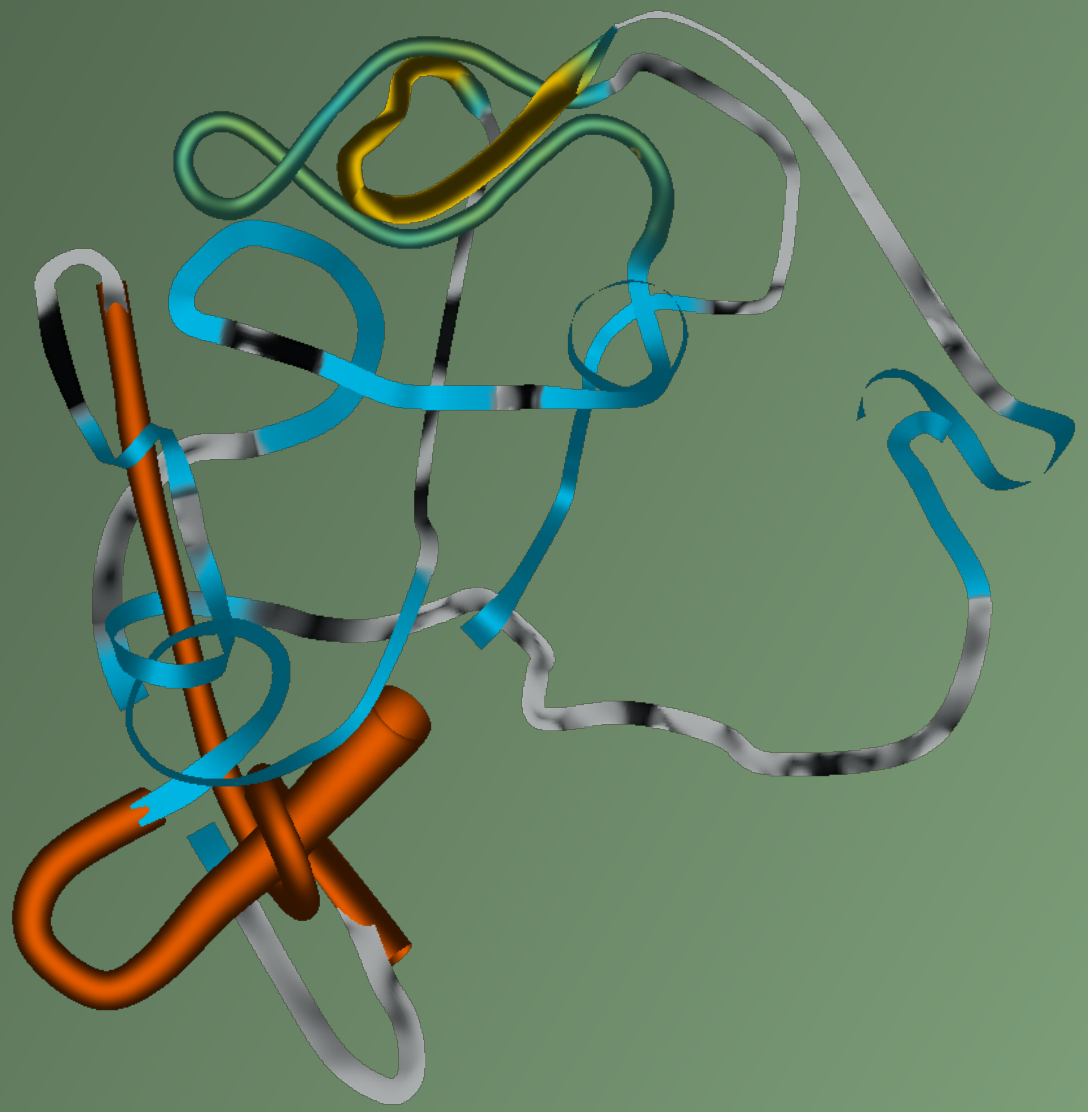
Minimap

Road:
Black – flat
Gray – bumps
Bright – tilted

Bridges - blue

Pipes - yellow
Halfpipes - green
OnPipe - orange

Besides that,
a lot of generated
statistics for track:
length, width, etc.



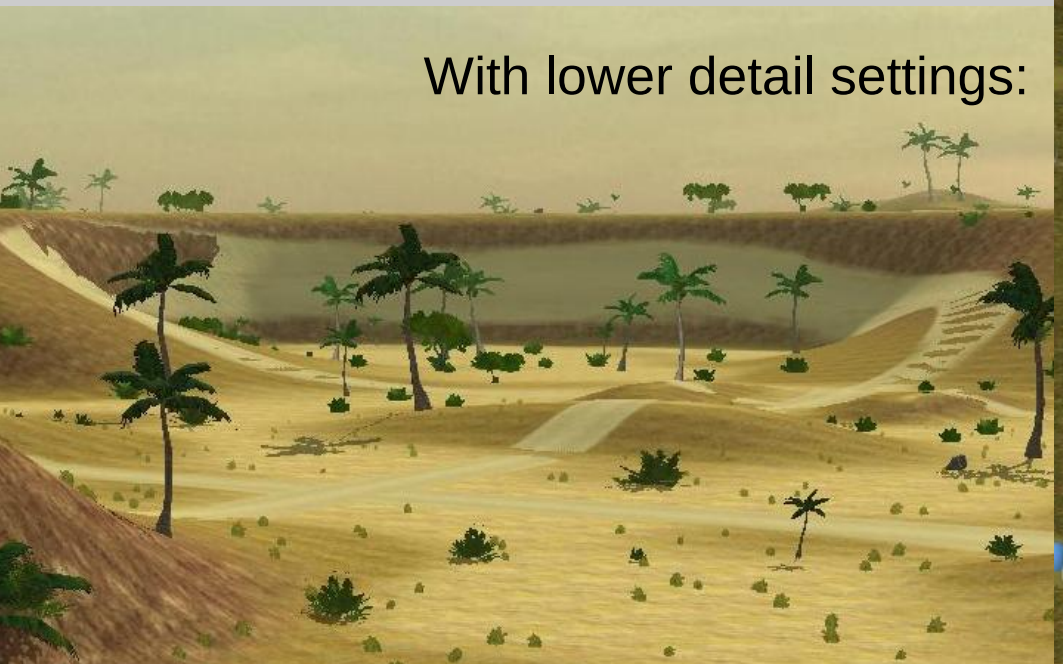
Road issues

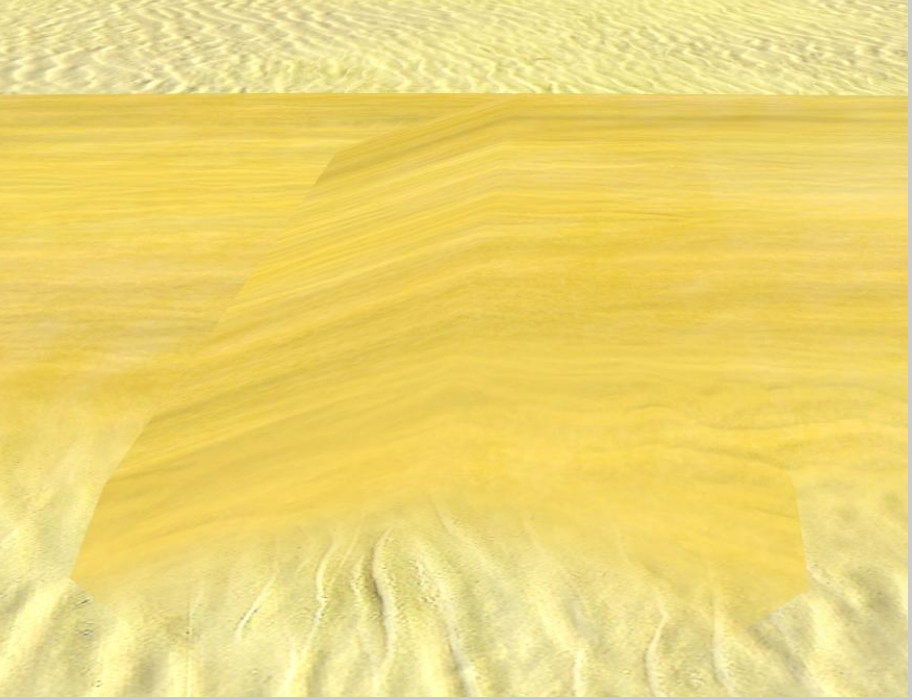
- **Tearing**

Fix: depth bias
and above terrain

- *No ditches near road or varying sides*

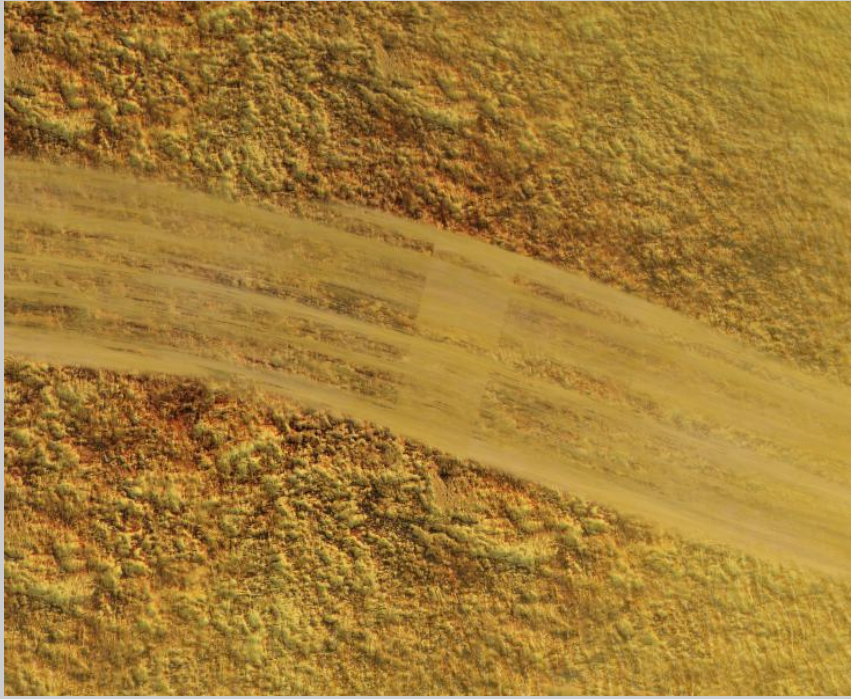
With lower detail settings:





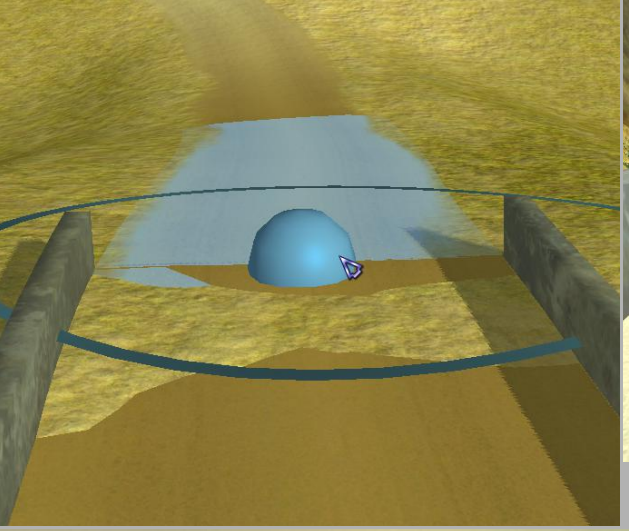
< Sorting
(only from side)

Transparent
not possible >
(skirt visible)

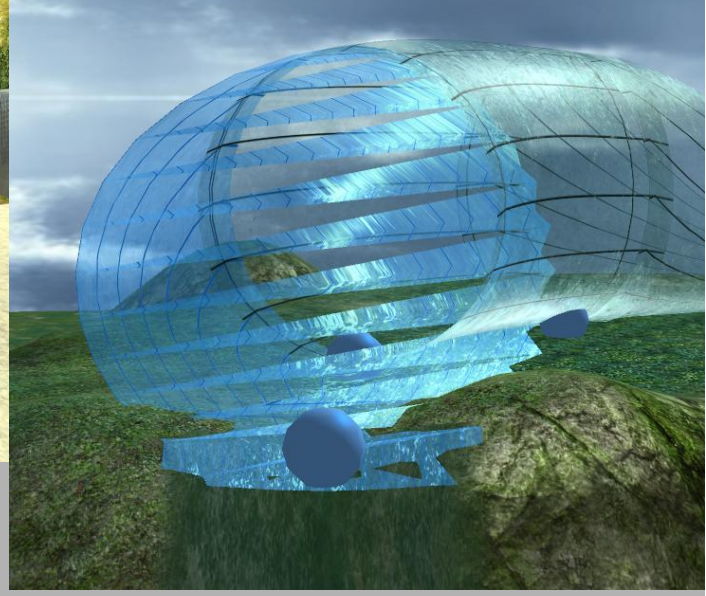


Skirt
Fixes gaps when
different LODs
Are visible near

- Crossings >

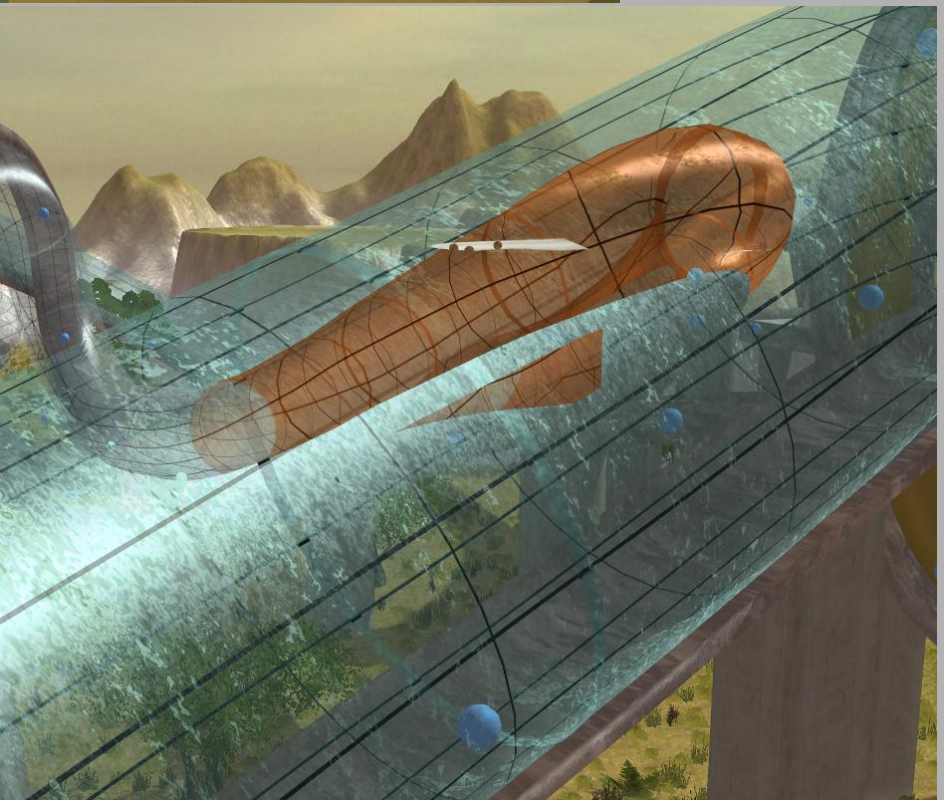


\ Bridge entries
(need extra time)

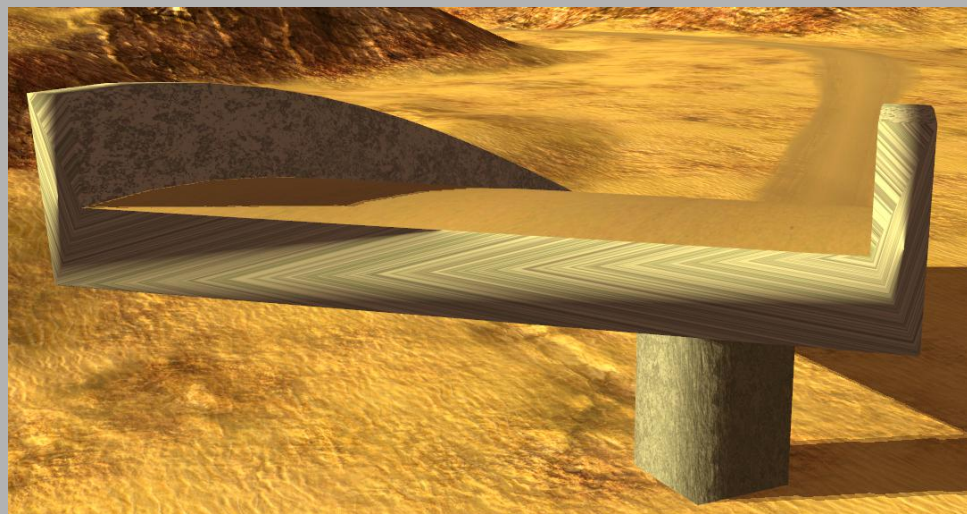


Fixed ^

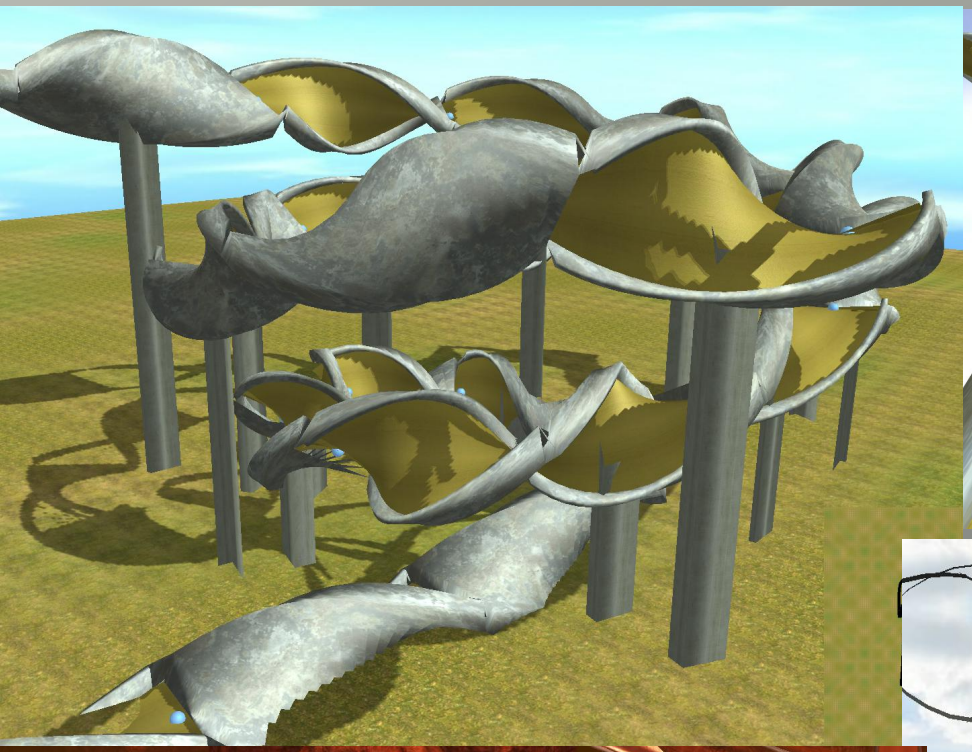
< Glass sorting

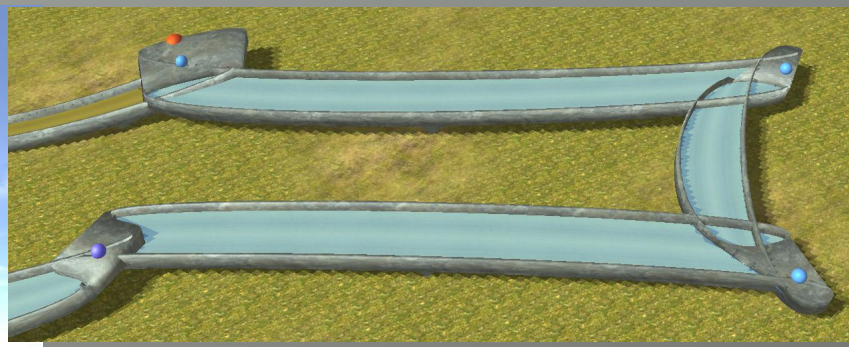


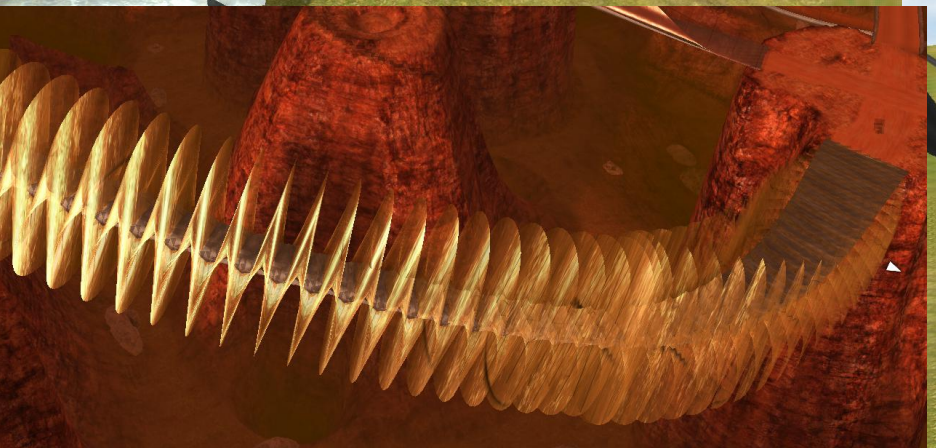
Jump fronts v

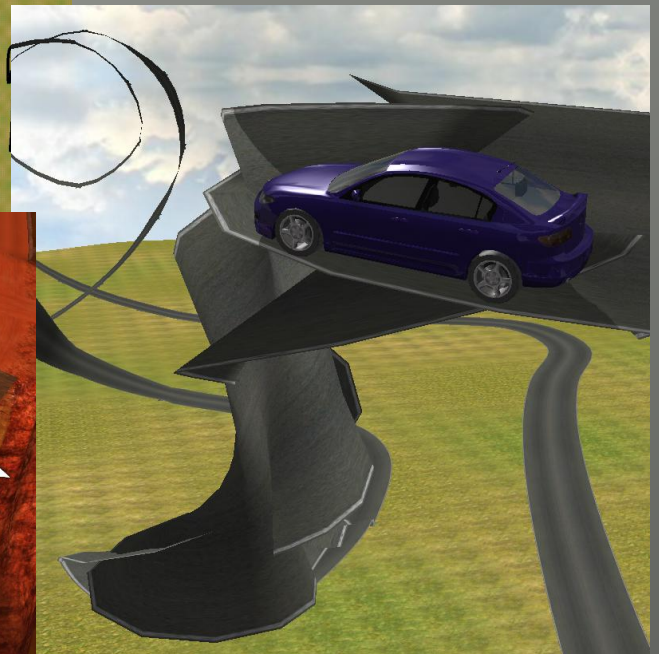


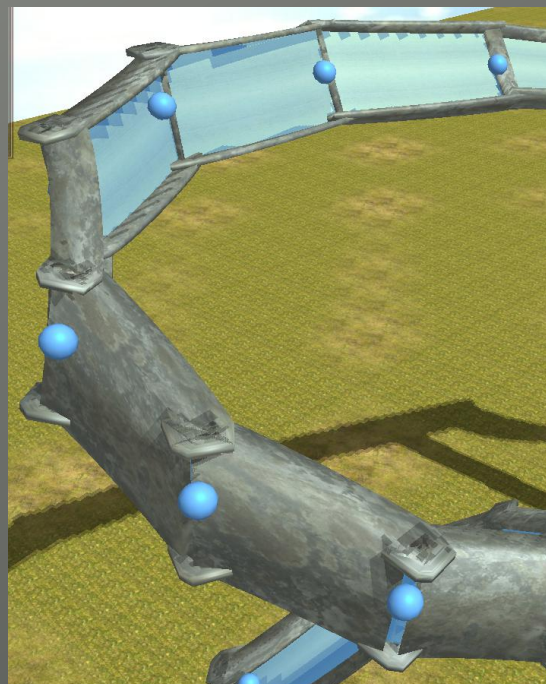
Funny temporary errors during development



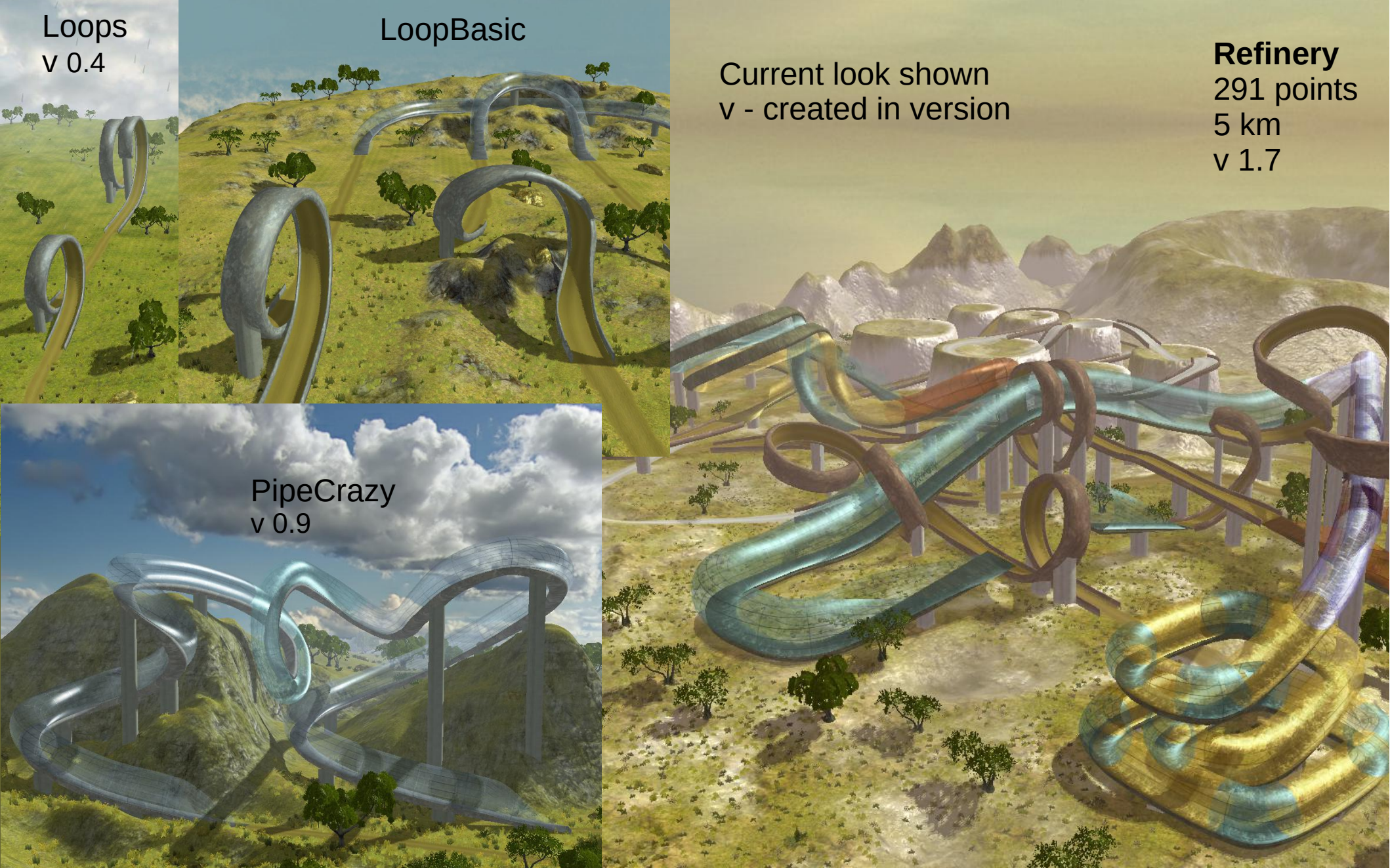




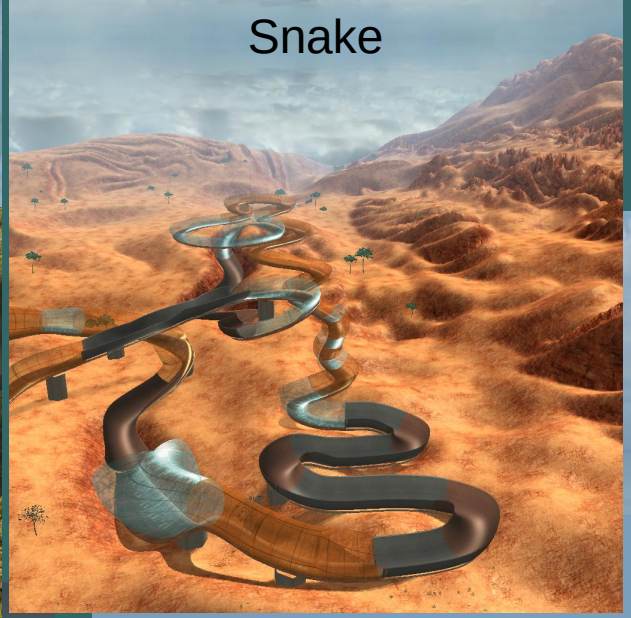




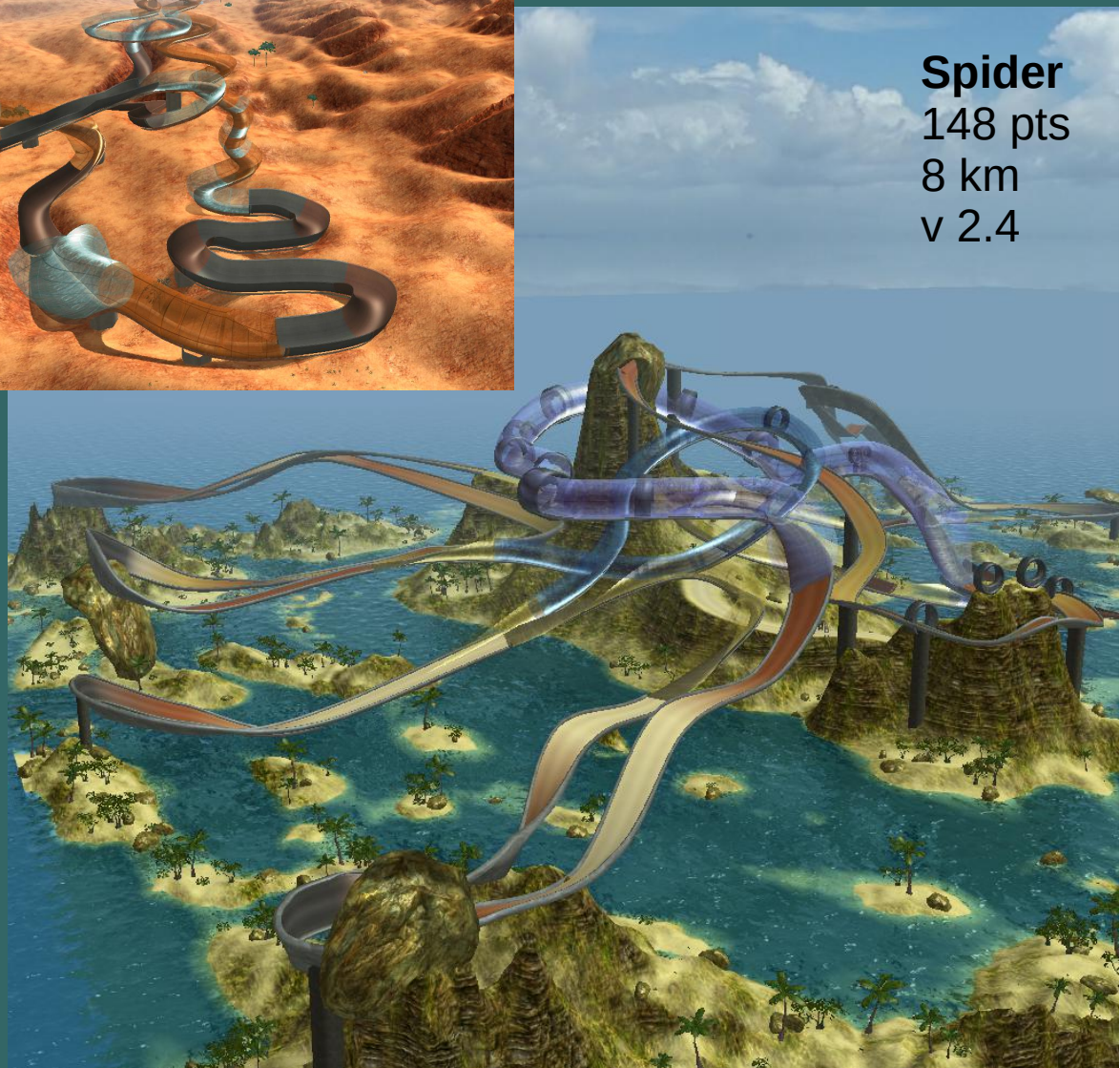
Examples of tracks
(with awesome road)


Loops
v 0.4
LoopBasic
PipeCrazy
v 0.9
Current look shown
v - created in version
Refinery
291 points
5 km
v 1.7

Halfpipes 2.2


Snake

Industrial

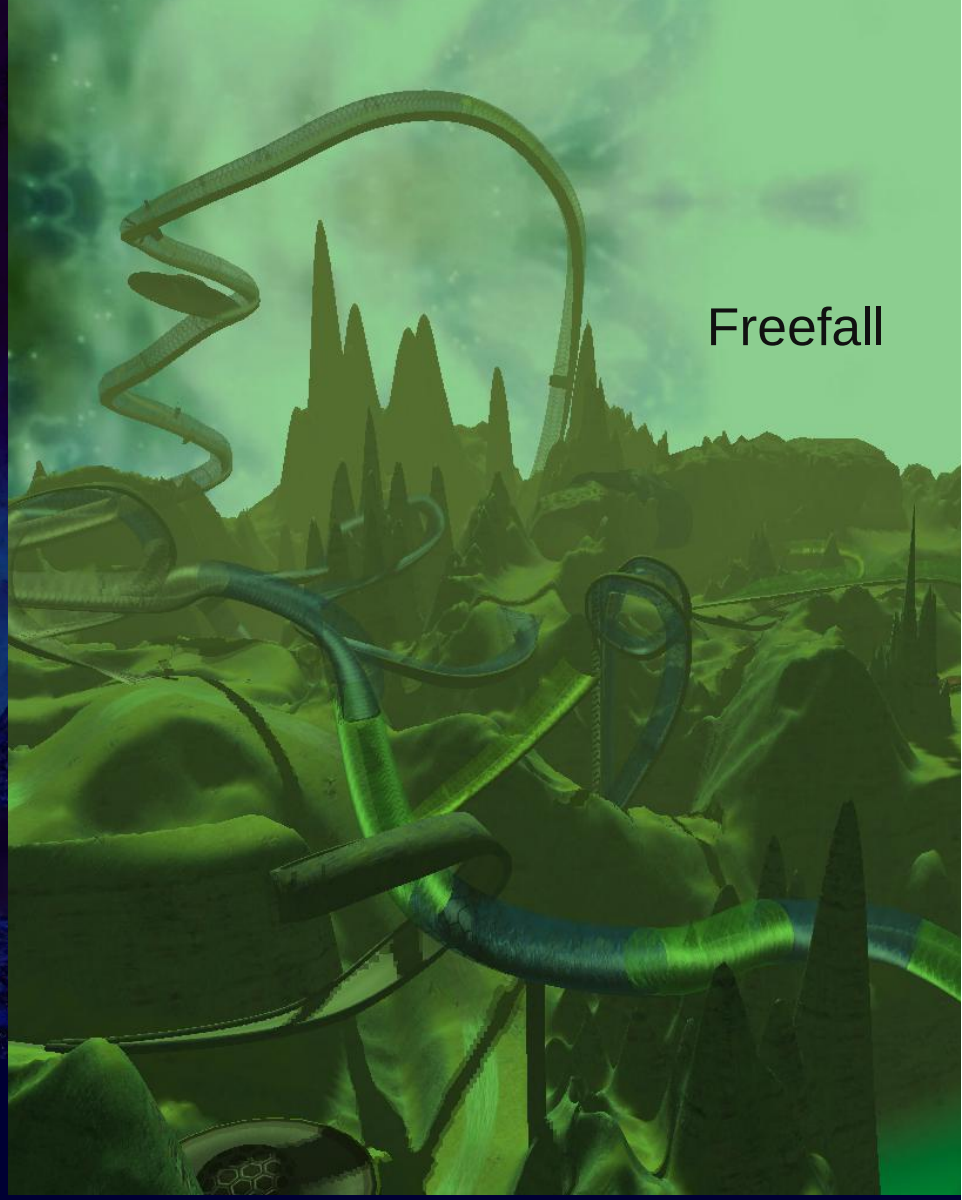

Spider
148 pts
8 km
v 2.4

PipeCoil
1.4 km
easy to drive

Ultima
521 pts
16 km
11 min

Factory
218 pts
5 km

Crematoria
9.4 km



Fps bar (left top corner)

Fps – frames per second (screen refreshes)
best if more than 60

Triangles – in k (thousands), best 300..800k

Batches – draw calls,
best below 300 (max 500)

GPU Memory in MB – how much used now,
Best if less than
what GPU has
(probably crash if more)
Assumed 512 MB

Fps Triang. Batch Memory

50.6	618k	391	416M
60.2	405k	235	417M
102.3	515k	161	347M
81.2	345k	121	417M
59.9	115k	70	272M

Side bug
Reaching light speed

Signs (Pacenotes)

My code, basing on **road**. About 600 lines.

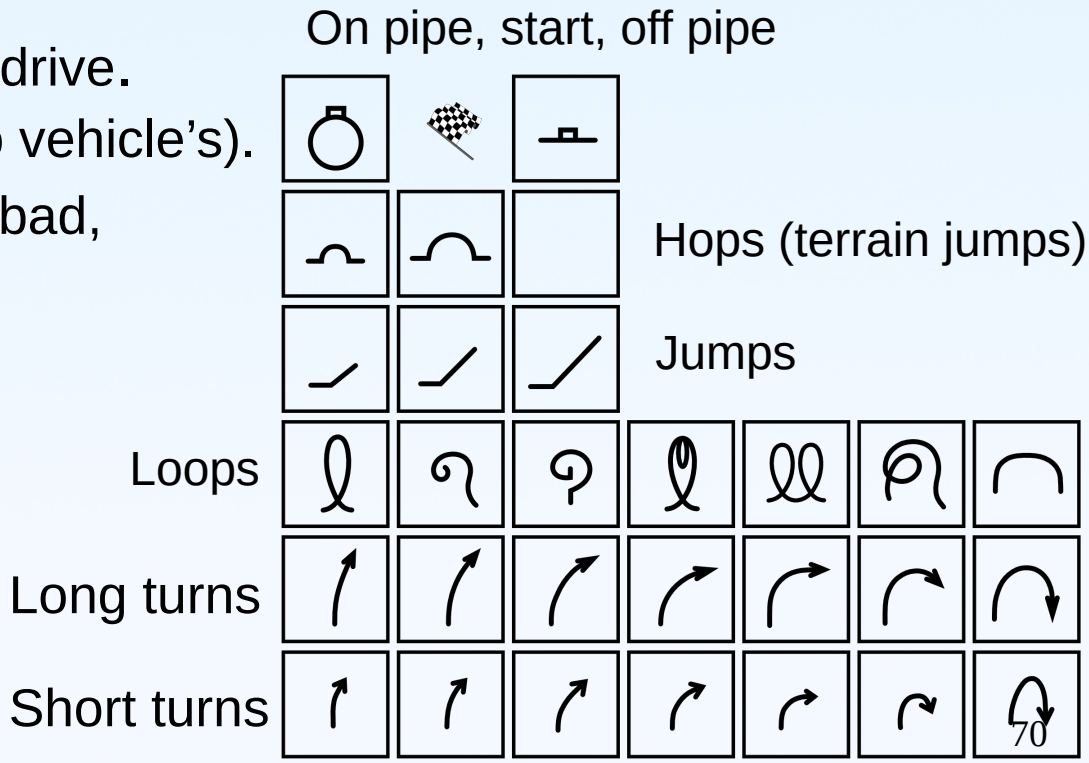
Automagically and fast generated. How on next slides..

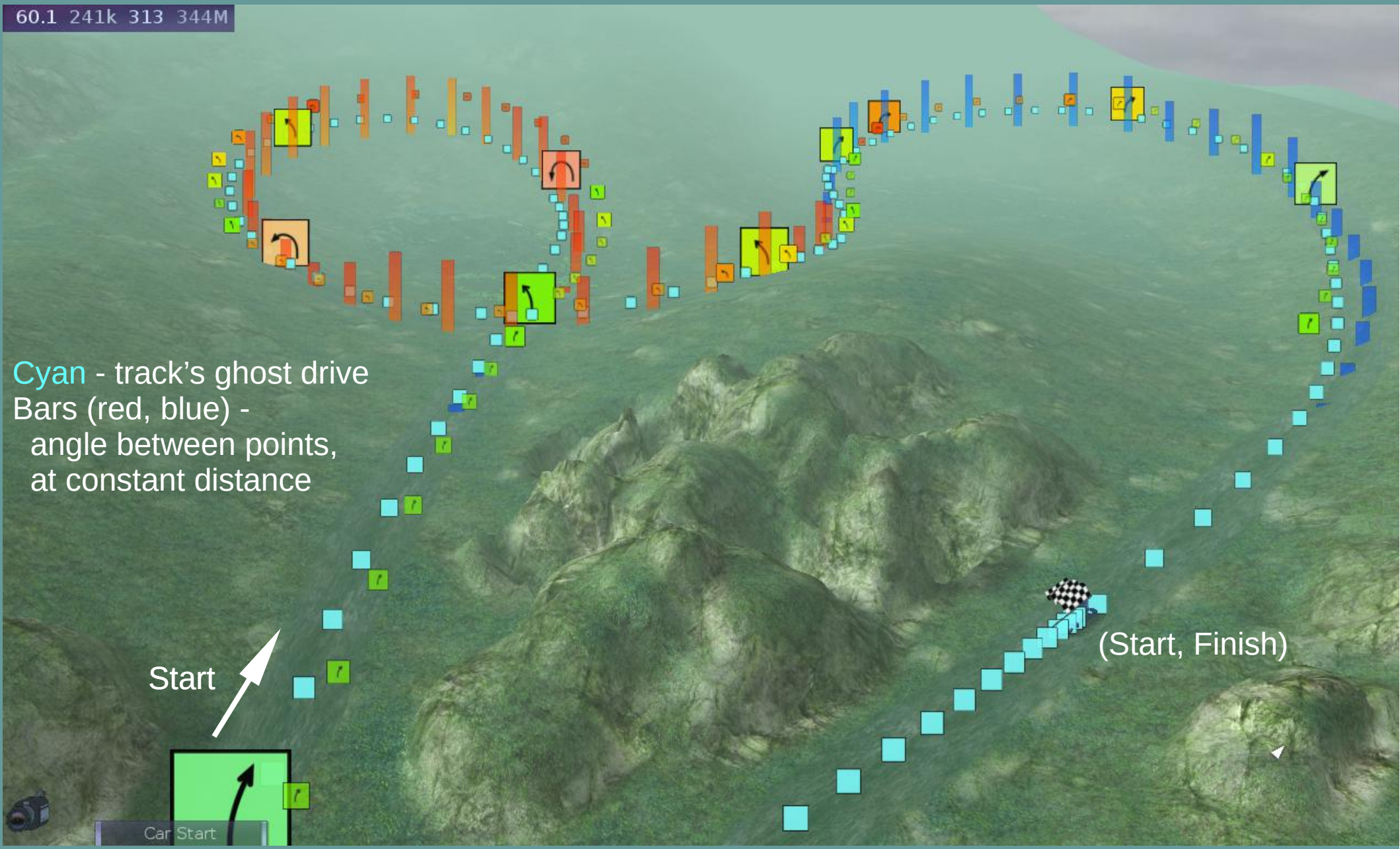
For hops (terrain jumps) and
jump speeds* uses track's **ghost** drive.
*change colour in game (relative to vehicle's).

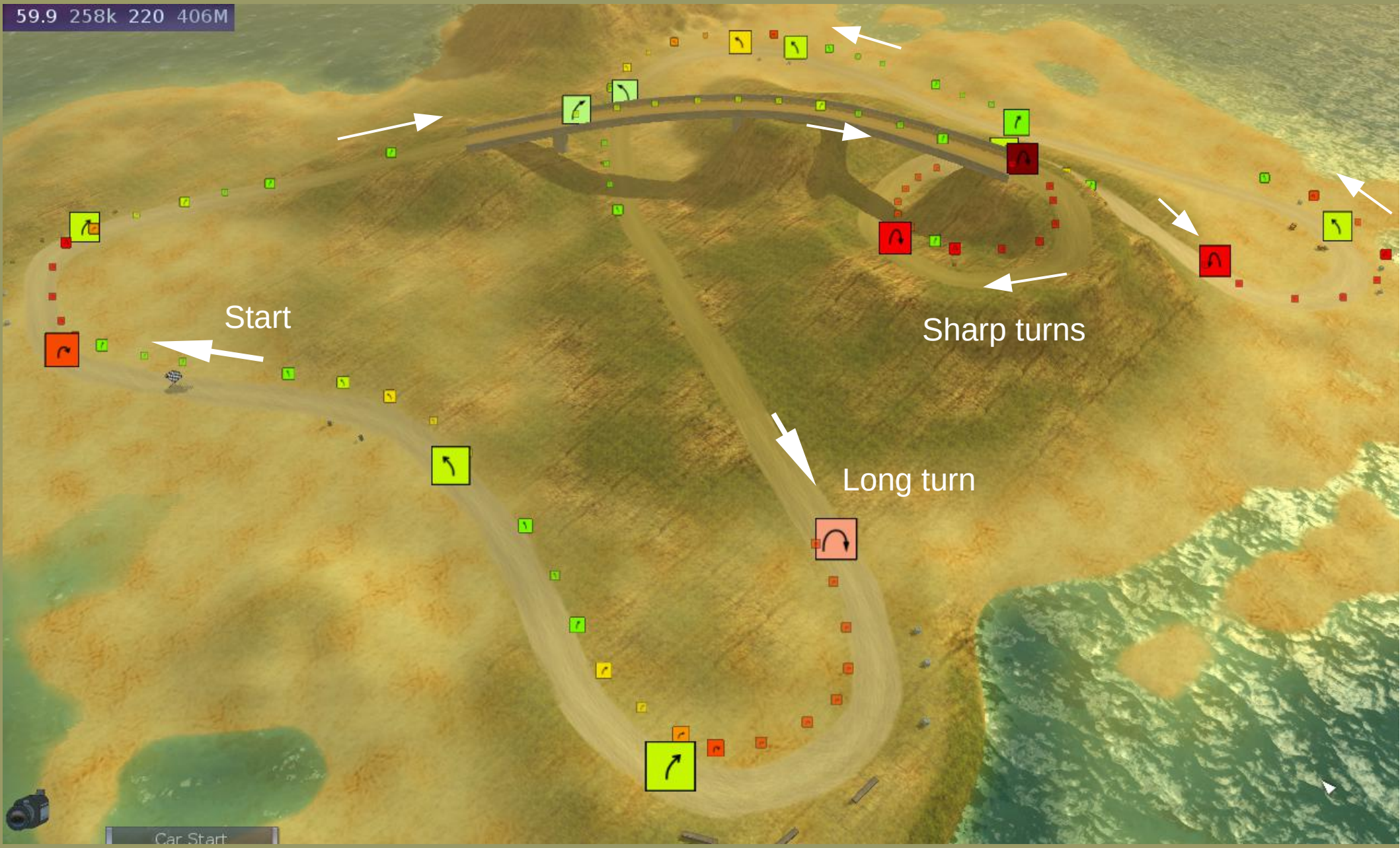
Unfortunately for some vehicles are bad,
since it depends on aerodynamics.

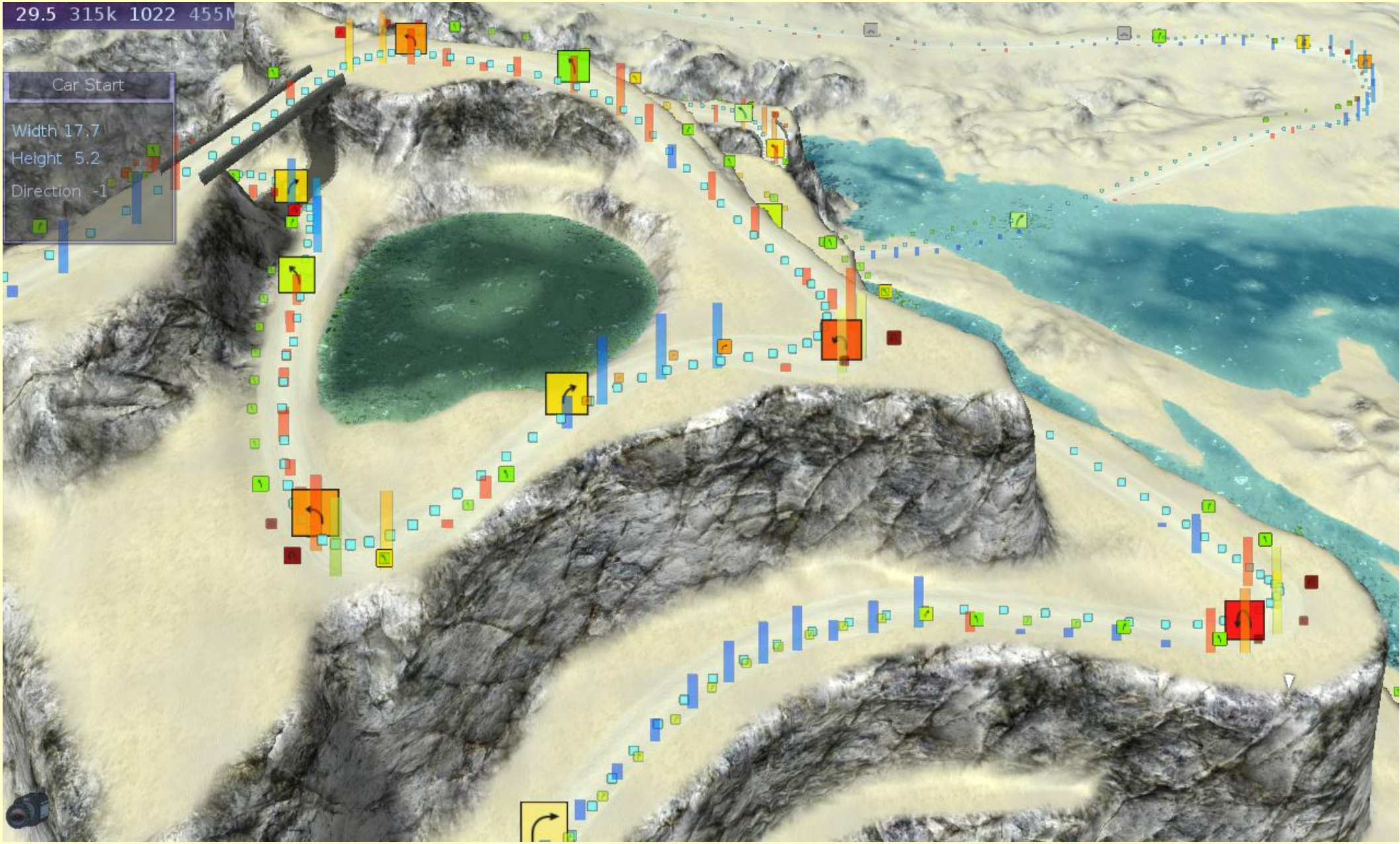
Manually only few:

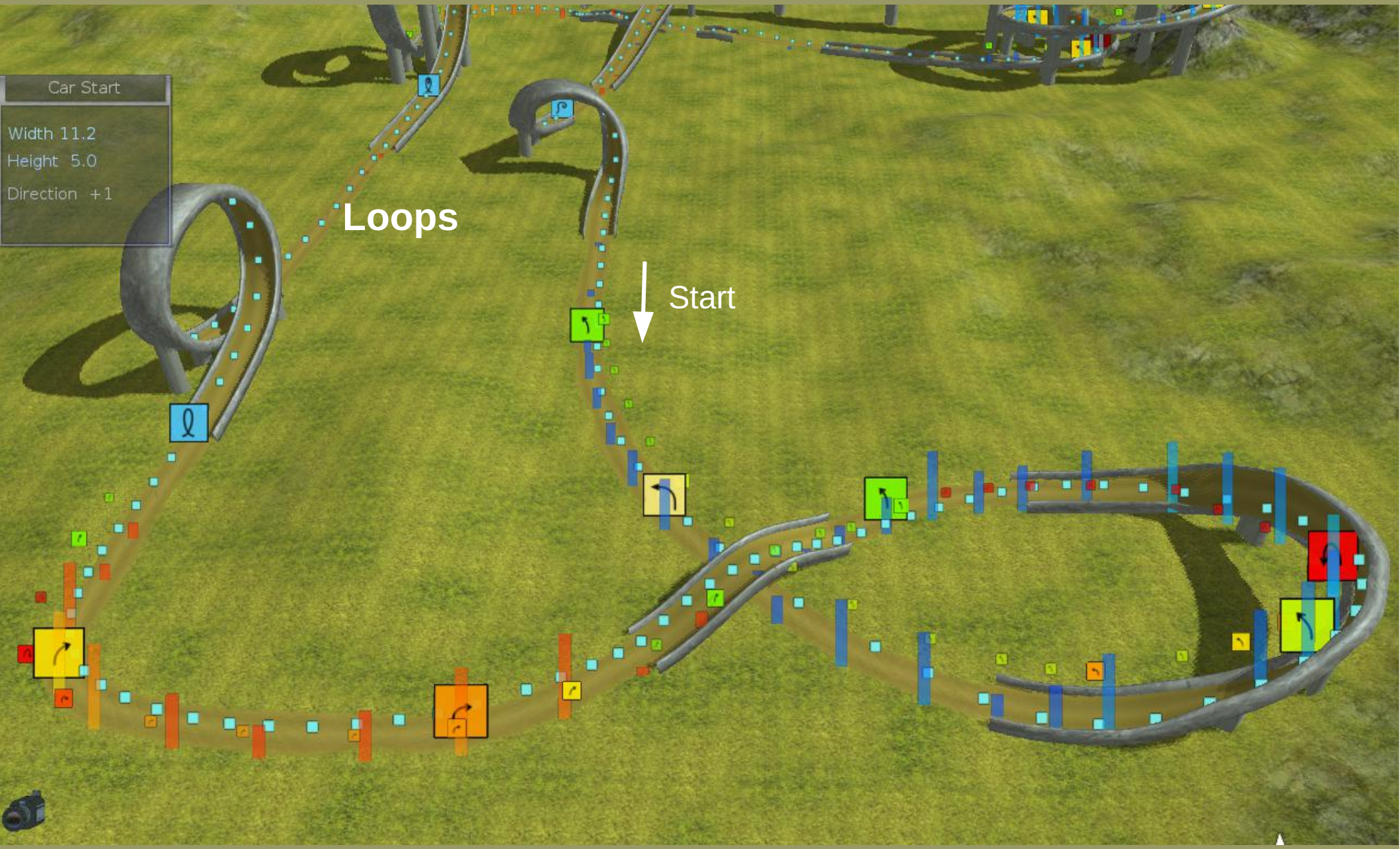
loop type, on pipe mark,
not real segments.

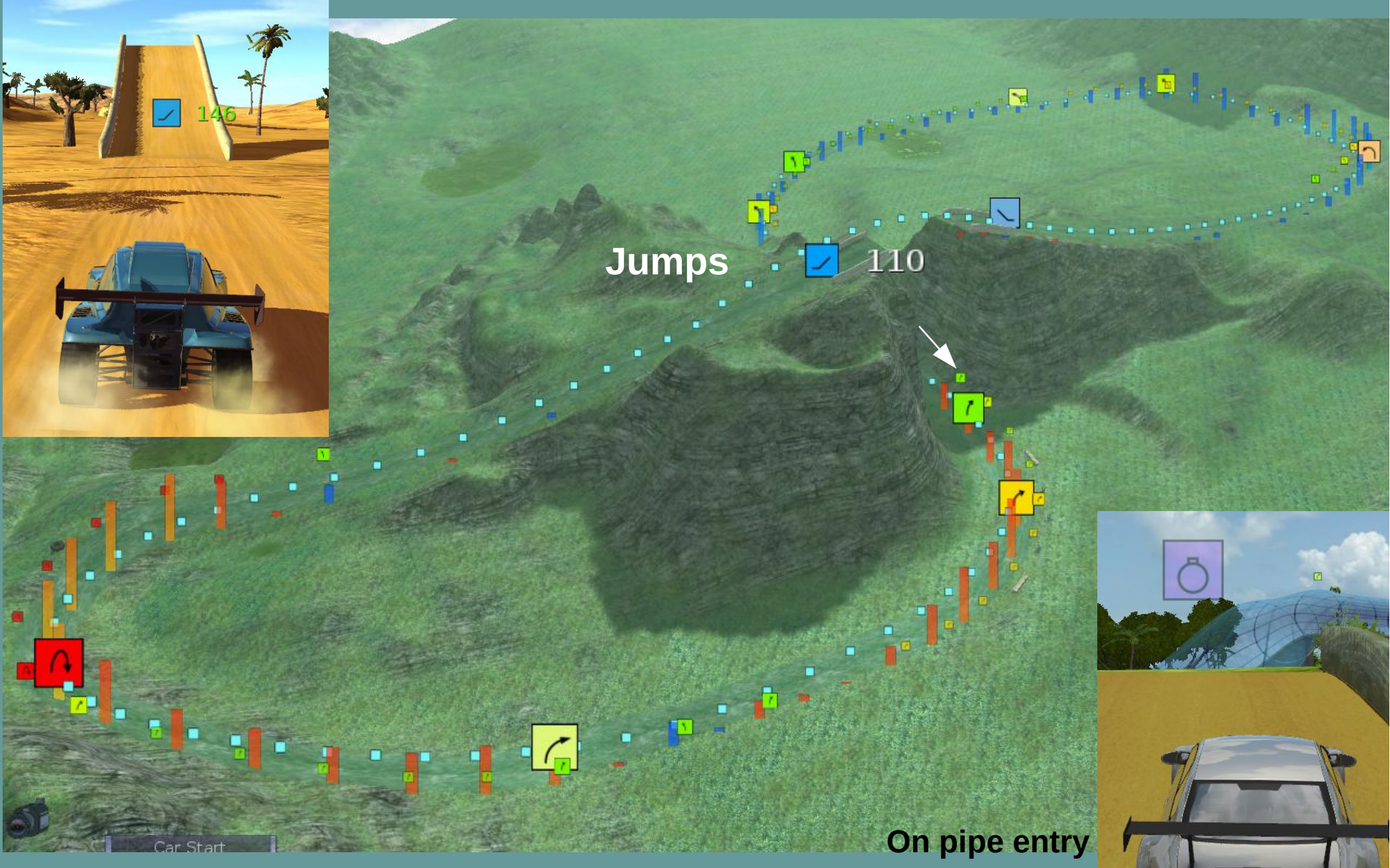



60.1 241k 313 344M
Cyan - track's ghost drive
Bars (red, blue) -
angle between points,
at constant distance
Start
(Start, Finish)
Car Start


59.9 258k 220 406M
Start
Sharp turns
Long turn
Car Start


29.5 315k 1022 455M
Car Start
Width 17.7
Height 5.2
Direction -1

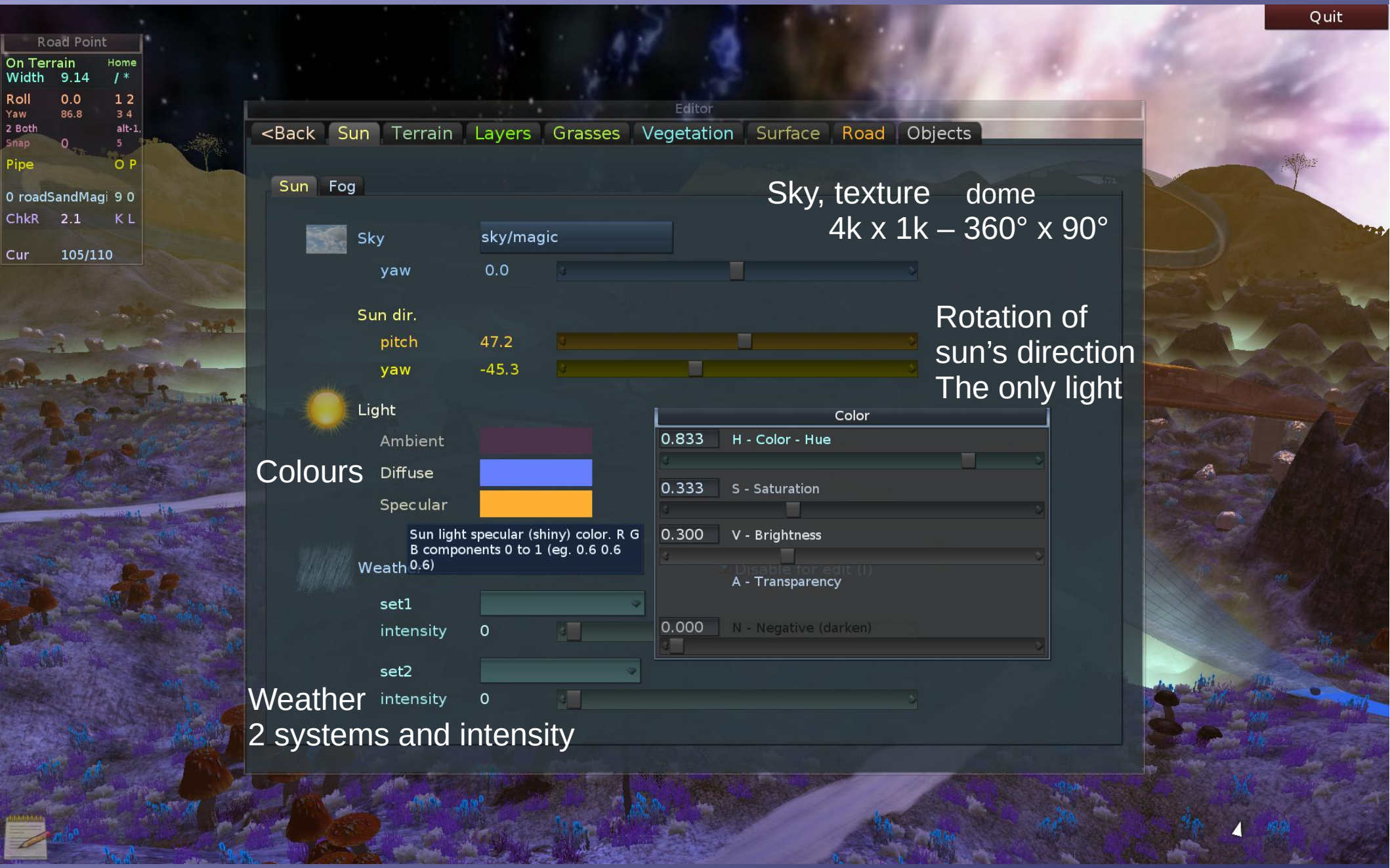

Car Start
Width 11.2
Height 5.0
Direction +1
Loops
Start


146
Jumps
110
Car Start
On pipe entry

Car Start
Width 11.2
Height 5.2
Direction +1
102
112

Editor:

Sun, Weather, **Fog**

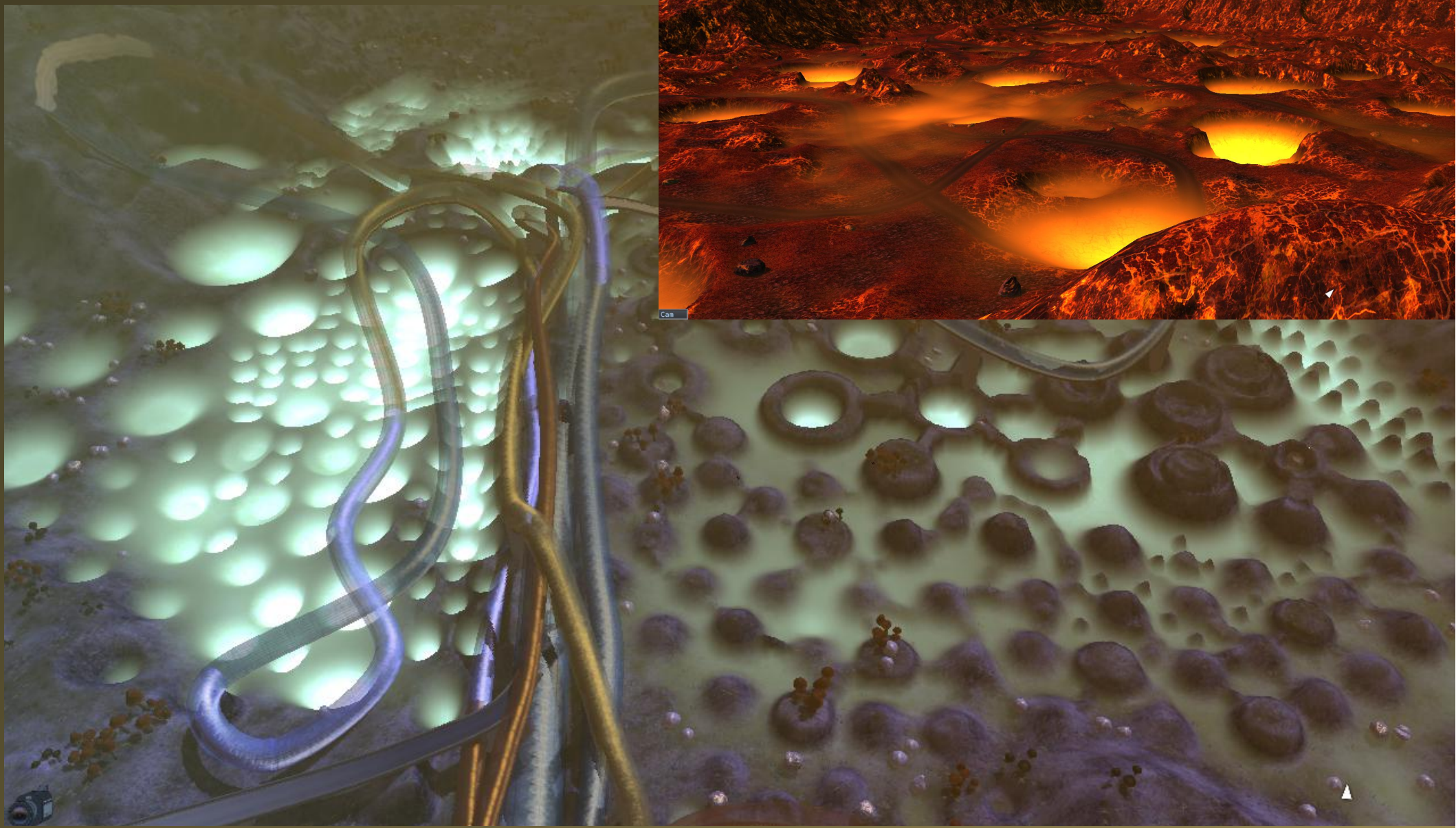

Quit
Road Point
On Terrain
Home
Width 9.14
/ *
Roll 0.0
1 2
Yaw 86.8
3 4
2 Both
alt-1,
Snap 0
5
Pipe
O P
0 roadSandMagi 9 0
ChkR 2.1
K L
Cur 105/110
Editor
<Back
Sun
Terrain
Layers
Grasses
Vegetation
Surface
Road
Objects
Sun
Fog
Sky, texture dome
4k x 1k – 360° x 90°
Sky
sky/magic
yaw
0.0
Sun dir.
pitch
47.2
yaw
-45.3
Rotation of
sun's direction
The only light
Light
Ambient
Colours
Diffuse
Specular
Sun light specular (shiny) color. R G B components 0 to 1 (eg. 0.6 0.6 0.6)
Weath
set1
intensity
0
set2
Weather
intensity
0
2 systems and intensity
Color
0.833
H - Color - Hue
0.333
S - Saturation
0.300
V - Brightness
Disable for edit (I)
A - Transparency
0.000
N - Negative (darken)

40.2 611k 335 302M
Time 3:11.90
Last -:--.---
Best -:--.---
Track -:--.---
Score --
Two colour fog,
view from top.
E.g. for sunset.
90%
Ghost
gear
kph
3.0
13
17/17 Arena Up low

Additional height based fog.

Fog code common for all materials and .shader-s in few places.

Luminescent fog (additive)



3D Graphics - shortly

Geometry

Points – vertices, vertex buffer

Have position Vector3 (x,y,z)
can have more e.g.:
Vec2 (u,v) for texture(s),
normal (Vec3) - perpendicular vector

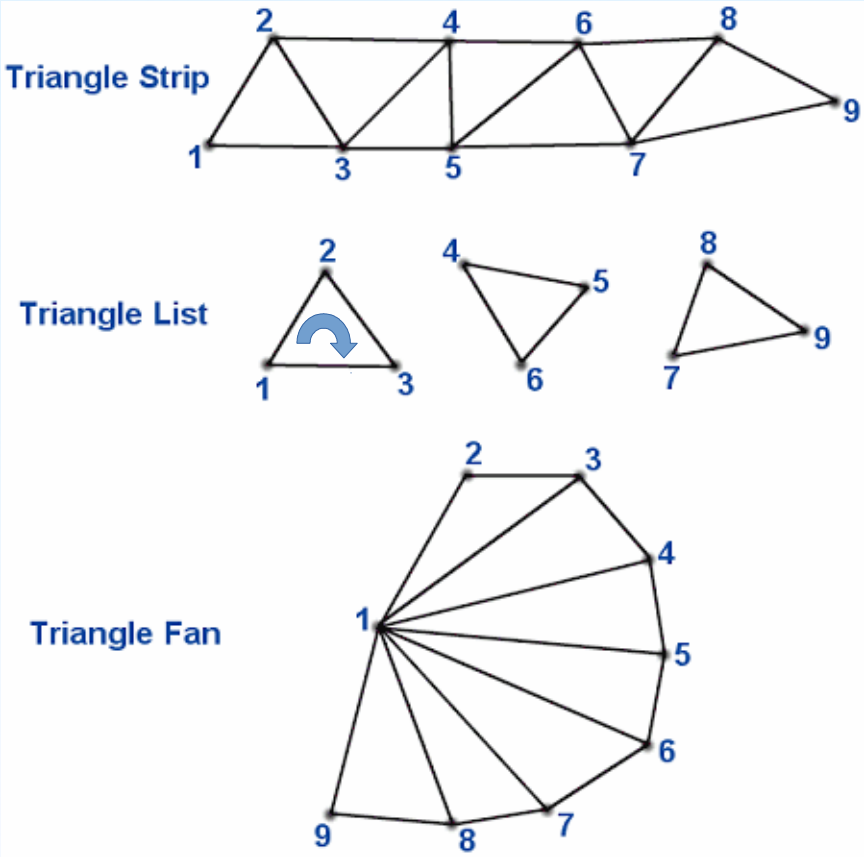
Indices – index buffer

one int16 or int32

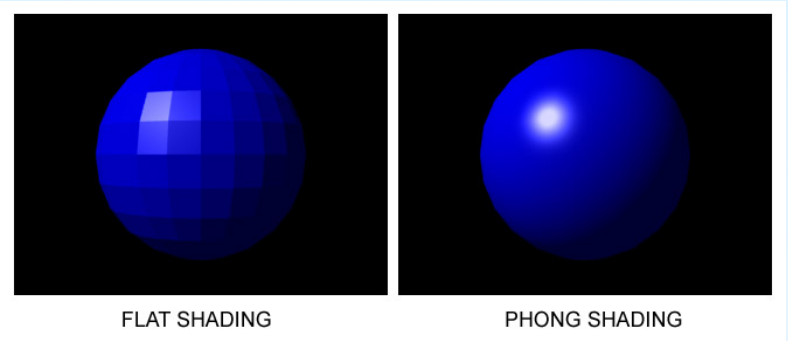
Triangles are made using indices >

Culling – omitting 1,2,3

e.g. when counter clockwise.
Thus not drawing back sides.

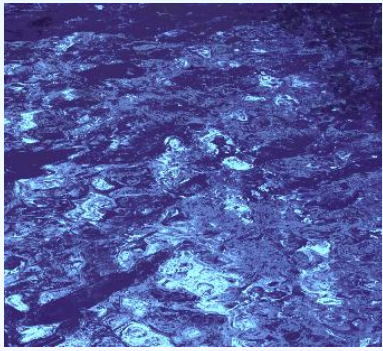


Shaders



Shader - C like code for GPU, *languages: HLSL, GLSL*
https://en.wikipedia.org/wiki/Shader

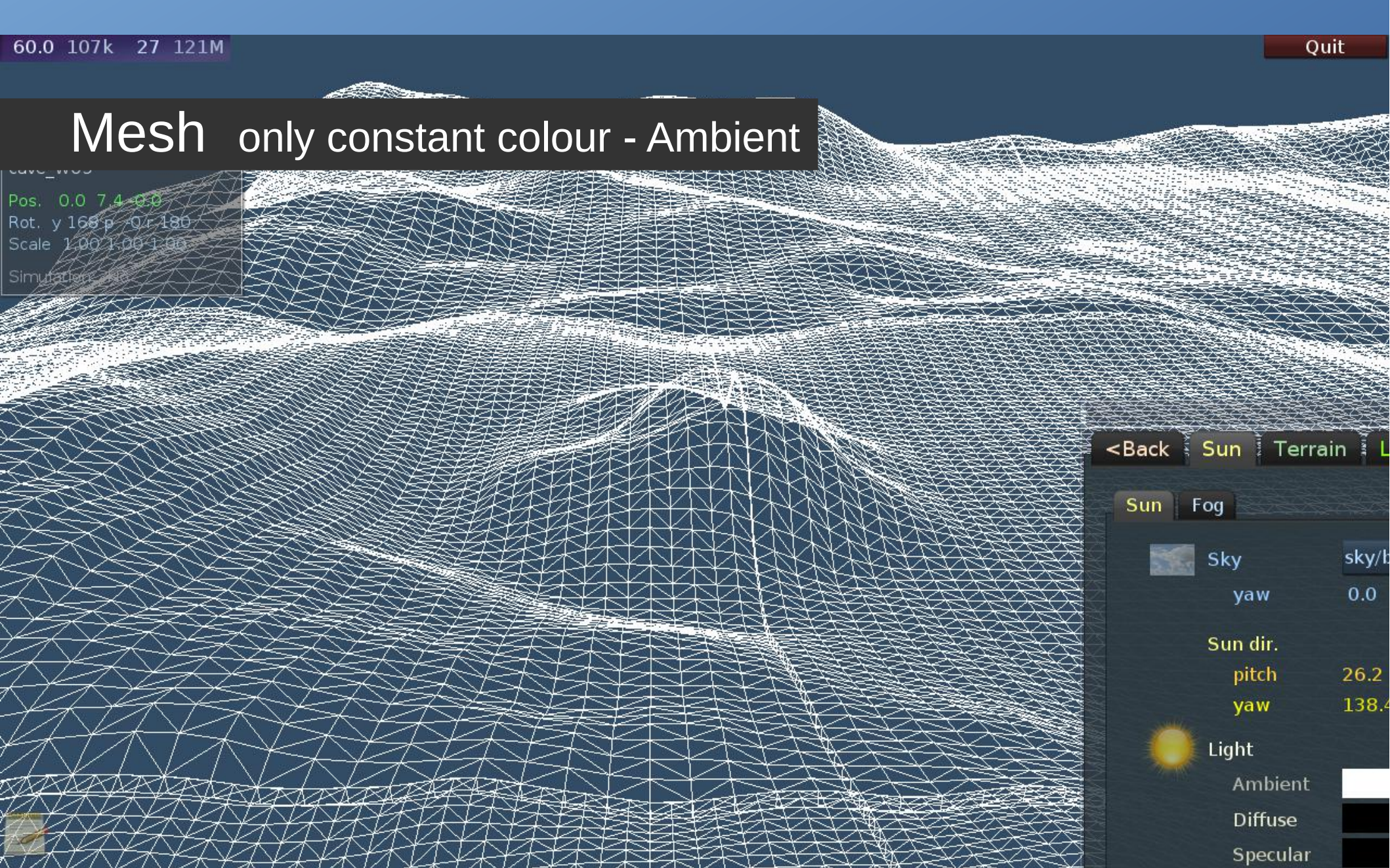
- Vertex shader – works on points:
  transforms positions from 3D to 2D
  (multiply by matrices 4x4: world, model, camera i projection)
  can modify them (e.g. water wave, wind)
  passes normal, u,v and other variables further (will be interpolated per pixel)
  newer ones can read textures



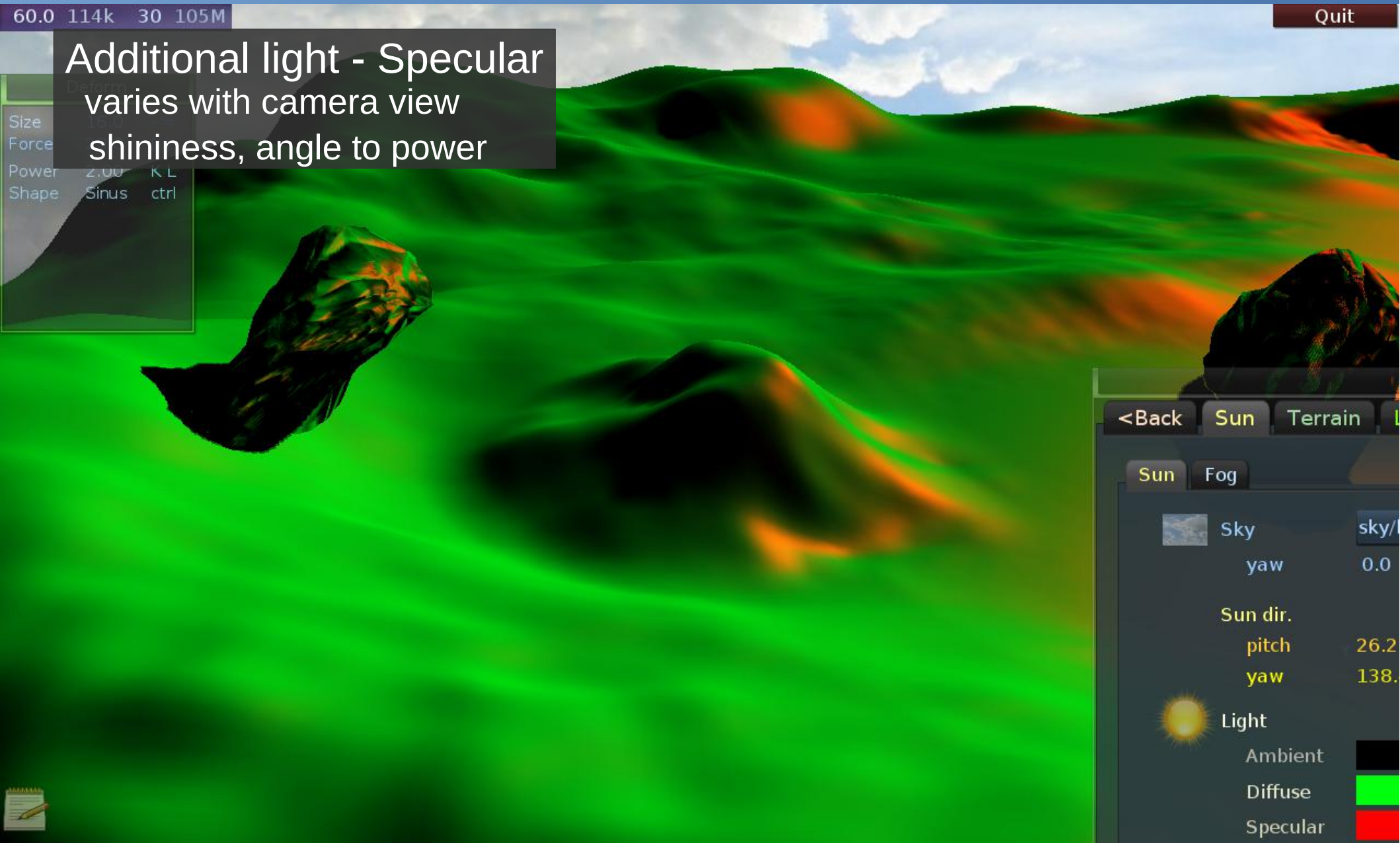
- Pixel (fragment) shader – works on pixels *(screen or texture's):*
  reads textures (using sampler units with smoothing/filtering)
  computes colour - lighting (vector reflections etc.) and adds effects
  e.g. bump mapping, reflection (mirror), water, etc.
  https://en.wikipedia.org/wiki/Blinn%E2%80%93Phong_shading_model

Other (newer, we don't have):
- Geometry shader - can create additional triangles (after Vertex shader)
- Tessellation shader - making geometry higher quality (more triangles)
- Compute shader (or OpenCL) - allows computing anything with GPU

Lighting – example from terrain


60.0 107k 27 121M
Quit
Mesh only constant colour - Ambient
Pos. 0.0 7.4 0.0
Rot. y 168 p -0 r 180
Scale 1.00 1.00 1.00
<Back
Sun
Terrain
Sun
Fog
Sky
yaw
0.0
Sun dir.
pitch
26.2
yaw
Light
Ambient
Diffuse
Specular

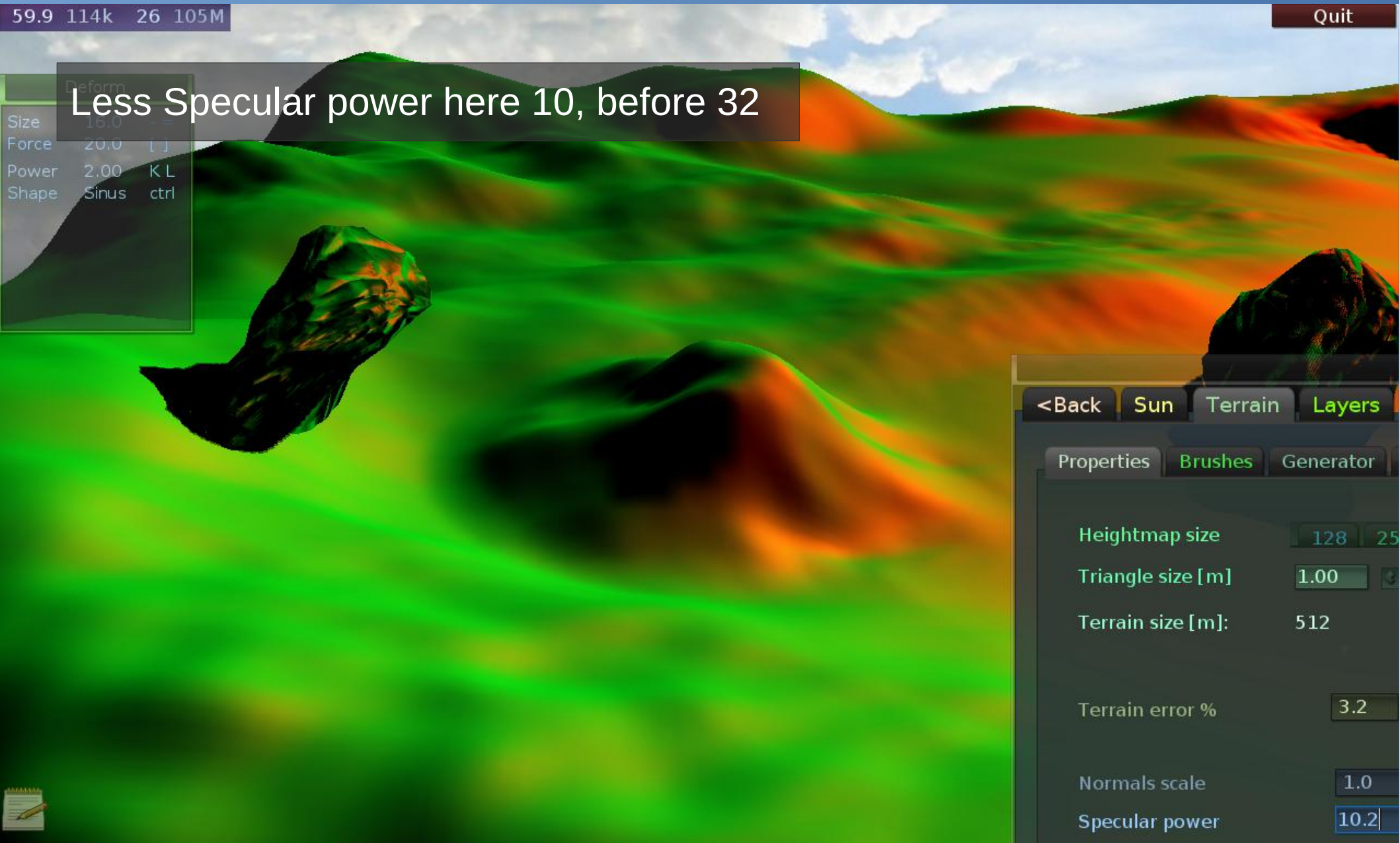
Only light – Diffuse
constant with camera view,
depends on mesh normal

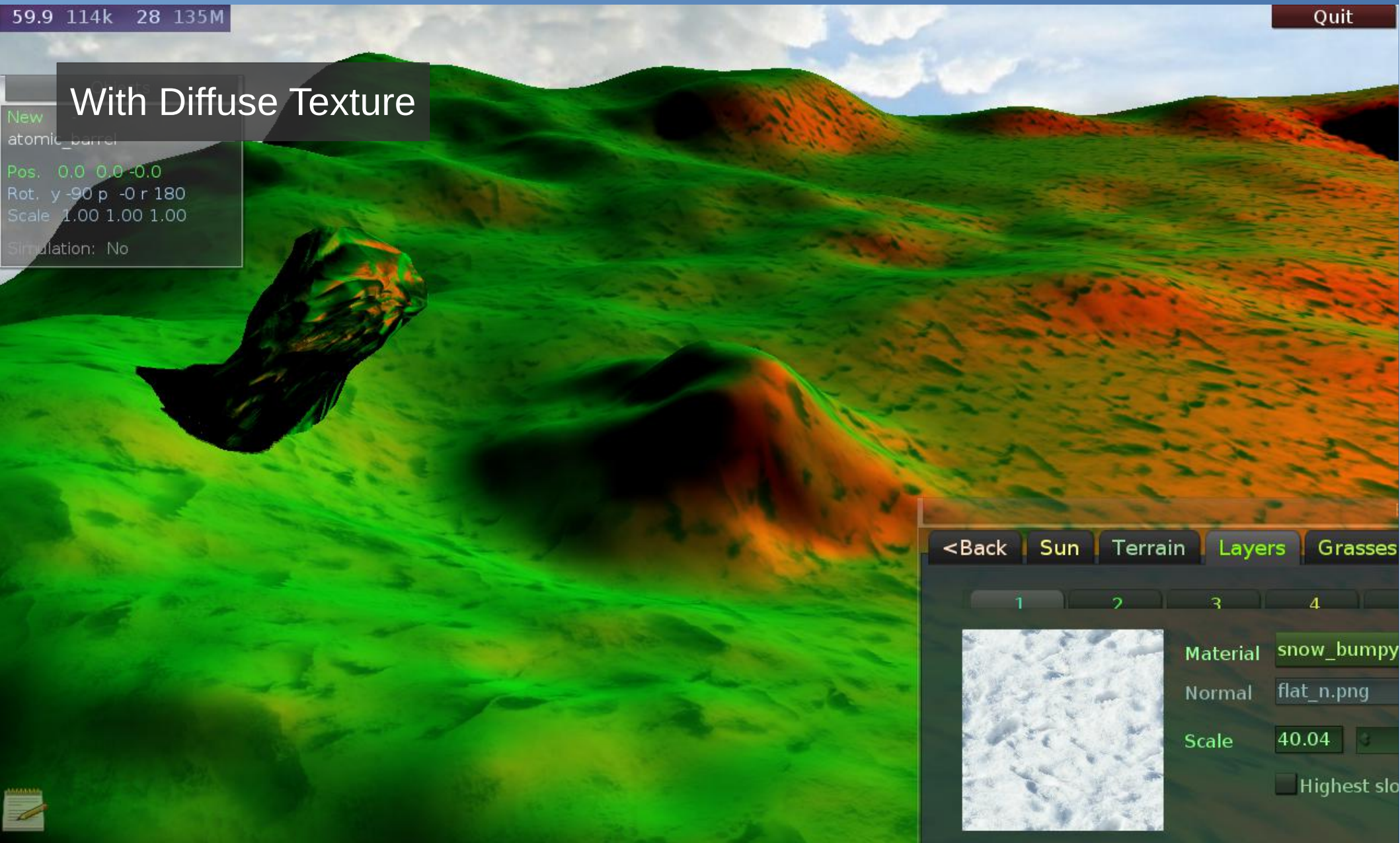


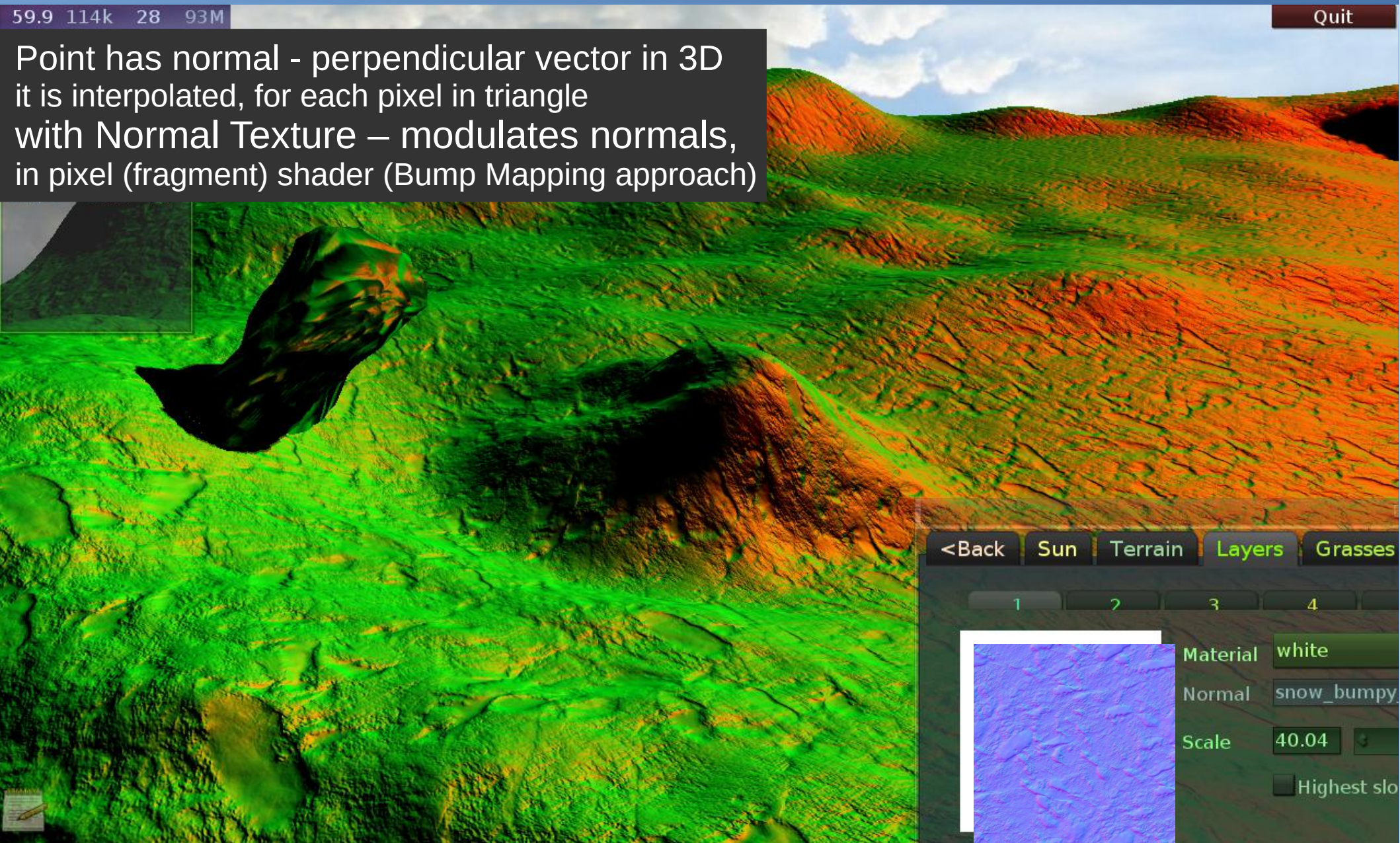
Additional light - Specular

varies with camera view

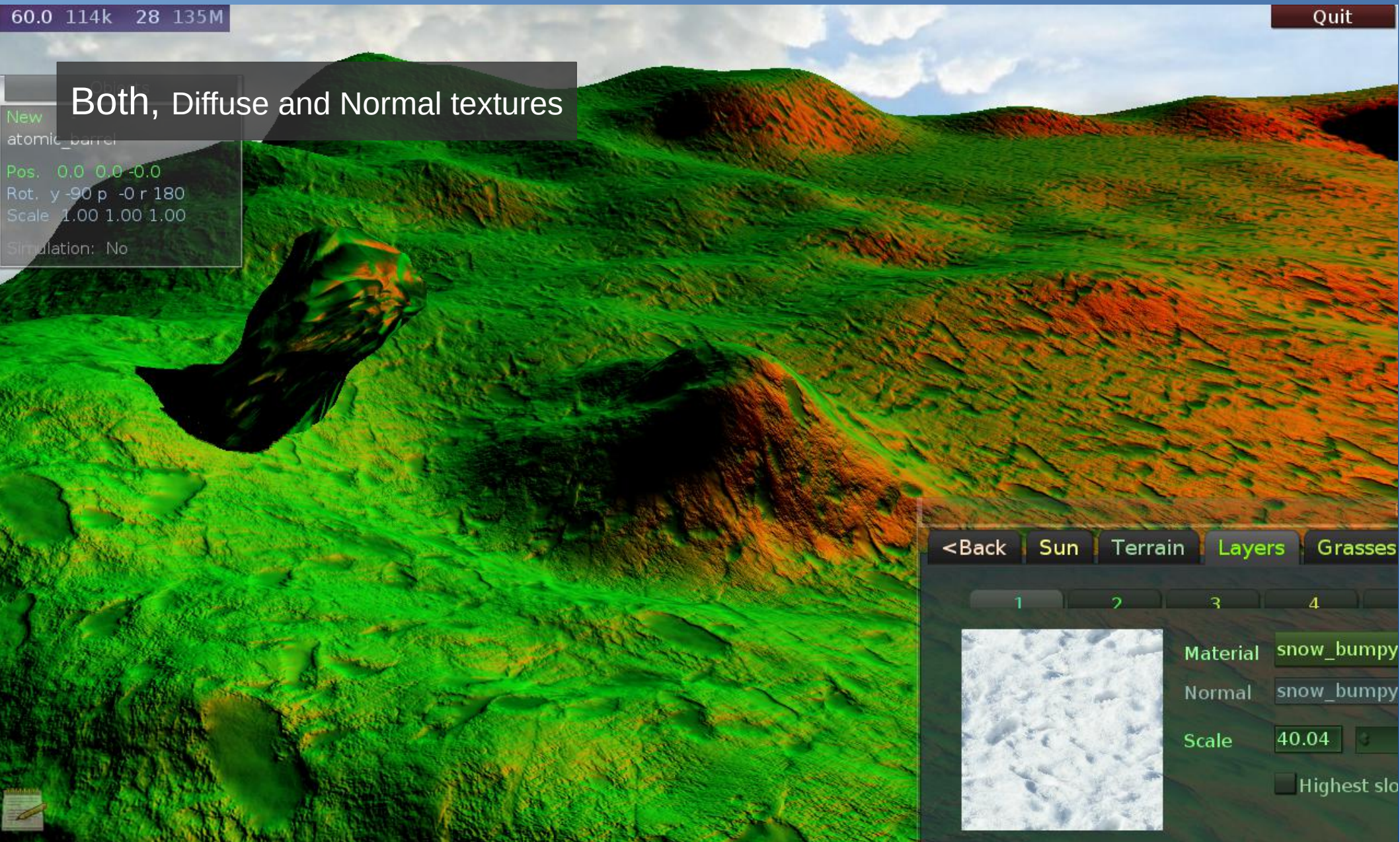
shininess, angle to power

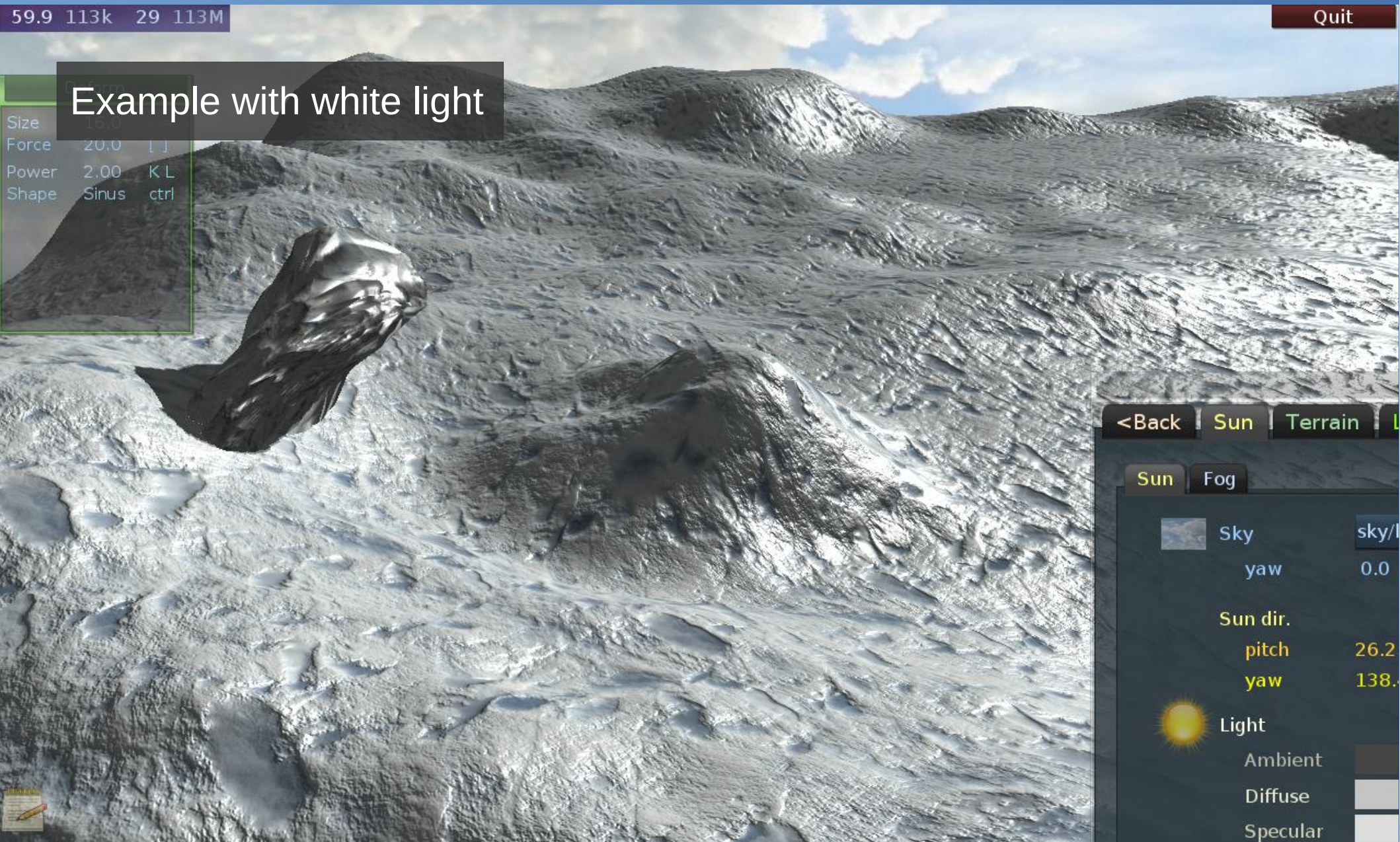

Less Specular power here 10, before 32
59.9 114k 26 105M
Quit
Deform
Size 16.0
Force 20.0
Power 2.00 K L
Shape Sinus ctrl
<Back
Sun
Terrain
Layers
Properties
Brushes
Generator
Heightmap size 128 25
Triangle size [m] 1.00
Terrain size [m]: 512
Terrain error % 3.2
Normals scale 1.0
Specular power 10.2


With Diffuse Texture
59.9 114k 28 135M
Quit
New
Pos. 0.0 0.0 -0.0
Rot. y -90 p -0 r 180
Scale 1.00 1.00 1.00
Simulation: No
<Back
Sun
Terrain
Layers
Grasses
1
2
3
4
Material
snow_bumpy
Normal
flat_n.png
Scale
40.04
Highest slo



Point has normal - perpendicular vector in 3D
it is interpolated, for each pixel in triangle
with Normal Texture – modulates normals,
in pixel (fragment) shader (Bump Mapping approach)

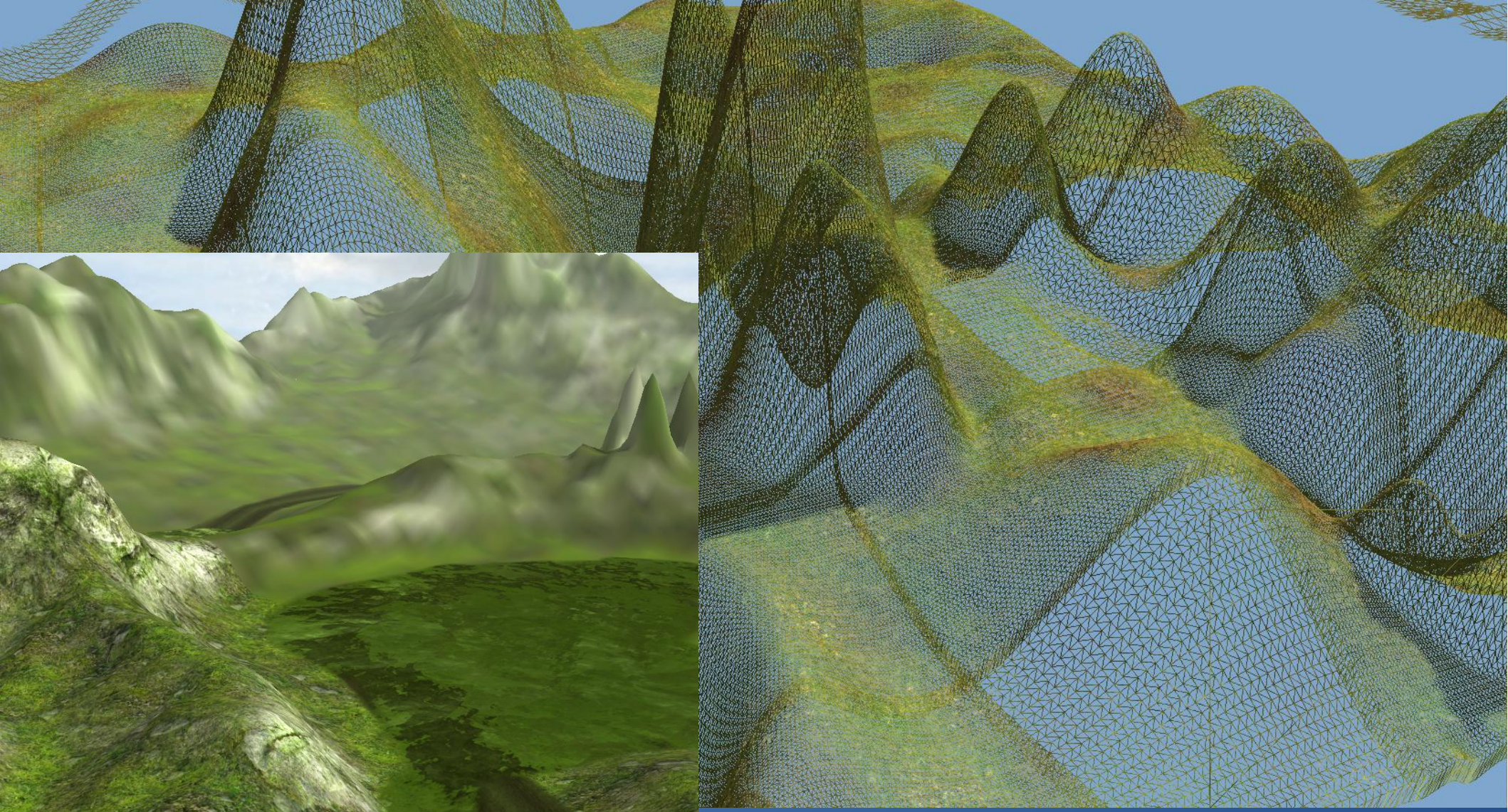

60.0 114k 28 135M
Quit
Both, Diffuse and Normal textures
New
atomic_barrel
Pos. 0.0 0.0 -0.0
Rot. y -90 p -0 r 180
Scale 1.00 1.00 1.00
Simulation: No
<Back
Sun
Terrain
Layers
Grasses
1
2
3
4
Material
snow_bumpy
Normal
snow_bumpy
Scale
40.04
Highest slo


59.9 113k 29 113M
Quit
Example with white light
Size
Force 20.0
Power 2.00 K L
Shape Sinus ctrl
<Back
Sun
Terrain
Sun
Fog
Sky
yaw 0.0
Sun dir.
pitch 26.2
yaw 138.
Light
Ambient
Diffuse
Specular

Game example (1 layer)

Terrain

height map



^ LOD, morphing, pages, error%

< Composite map – far

Terrain heightmap and advanced

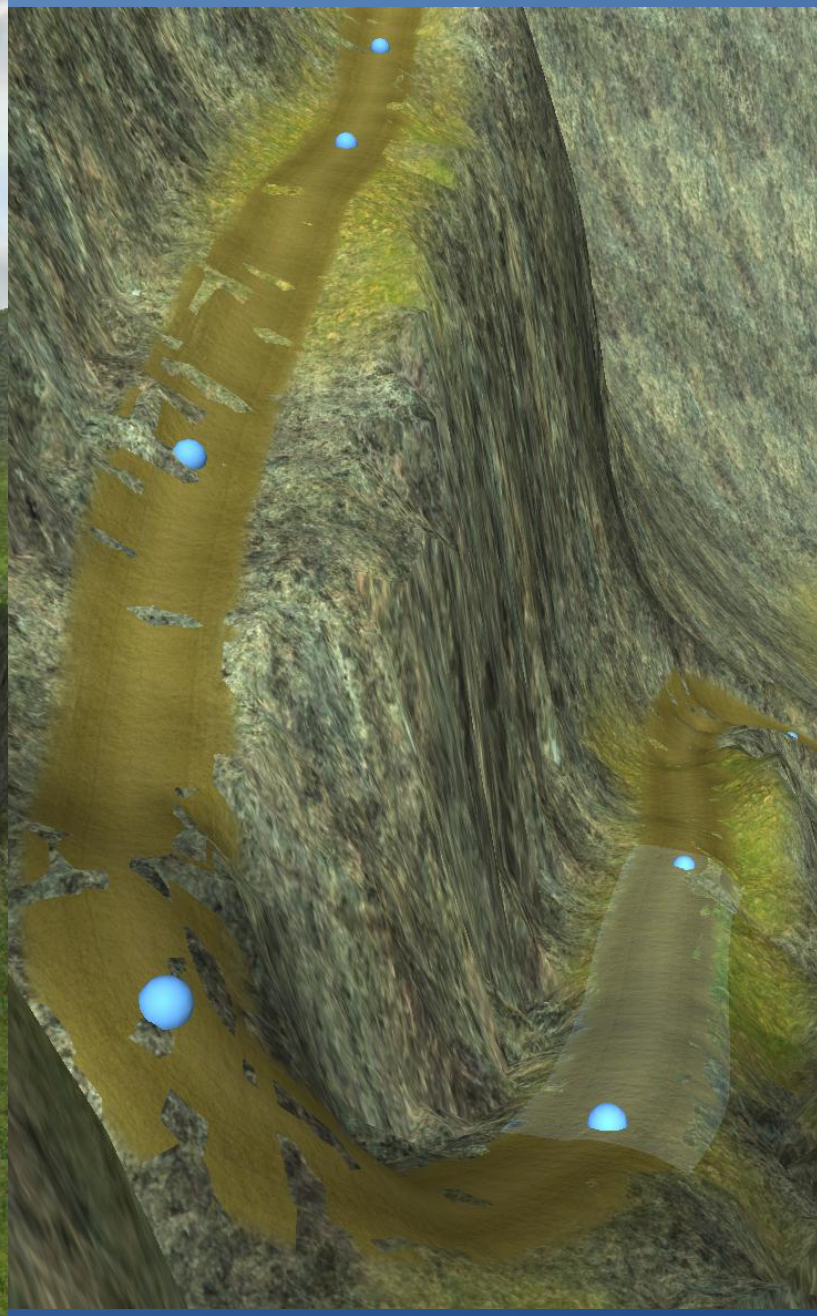
Terrain brushes, 4 types
Quit
Deform
Size 60.0 - =
Force 20.0 [ ]
Power 1.40 K L
Shape Noise ctrl
Freq 0.30 O P
Octaves 4 N M
Offset 0.0 9 0
Editor
<Back
Sun
Terrain
Layers
Grasses
Vegetation
Surface
Road
Objects
Properties
Brushes
Generator
Tools
Filter
Deform
Set Height
Smooth
Many noise presets
bold holes 3
Terrain is like a canvas and needs to be painted in all places using (at least few) different brushes.

Terrain generator

Edit whole terrain fast, good for start.

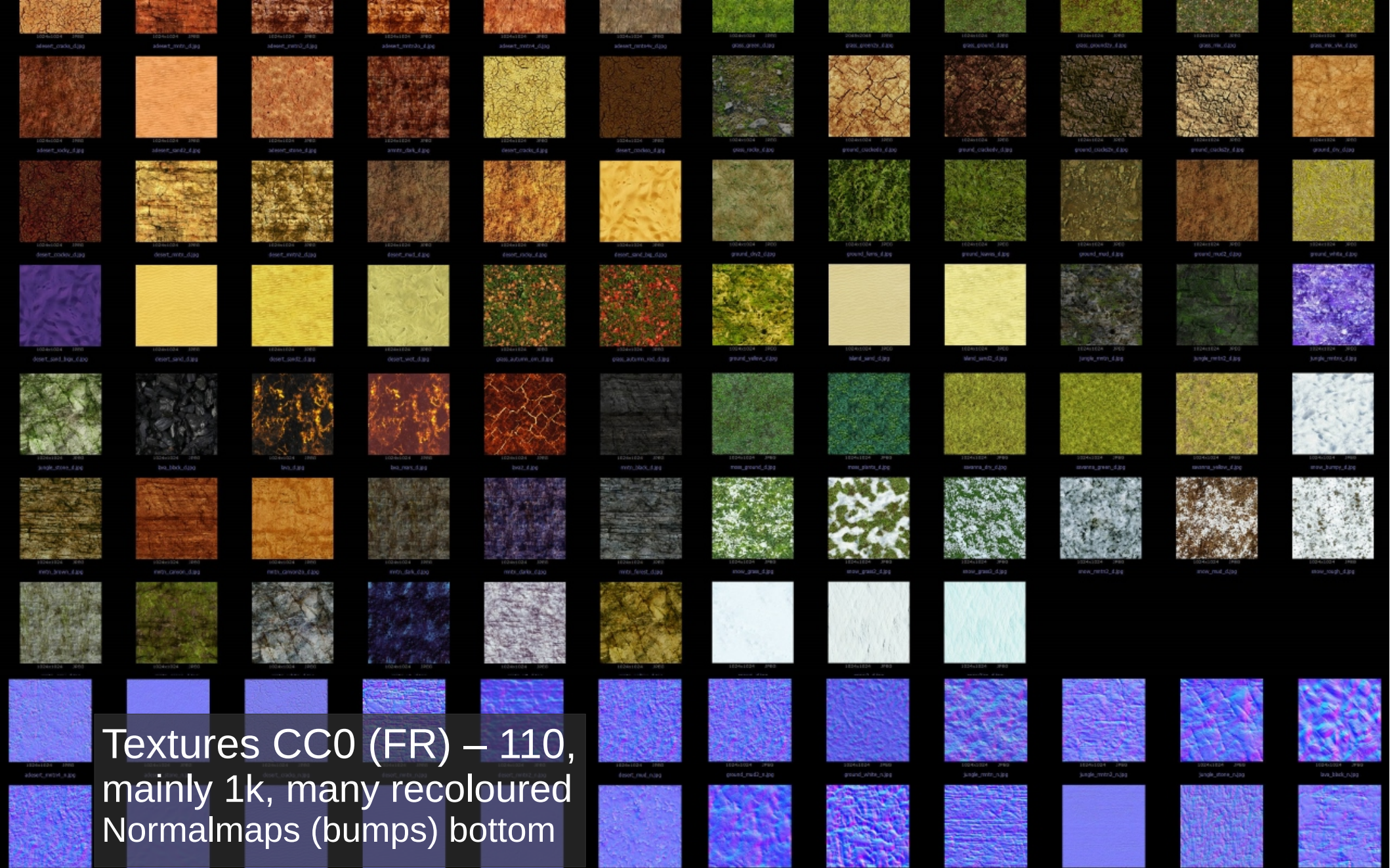
Terrain align to road. First we make a bridge, going through terrain.
After it, terrain is under regular road.
Casts rays from top for each terrain point.

Earlier > problems

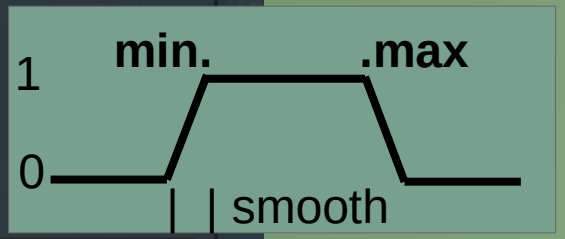


Terrain
Layers and Blendmap

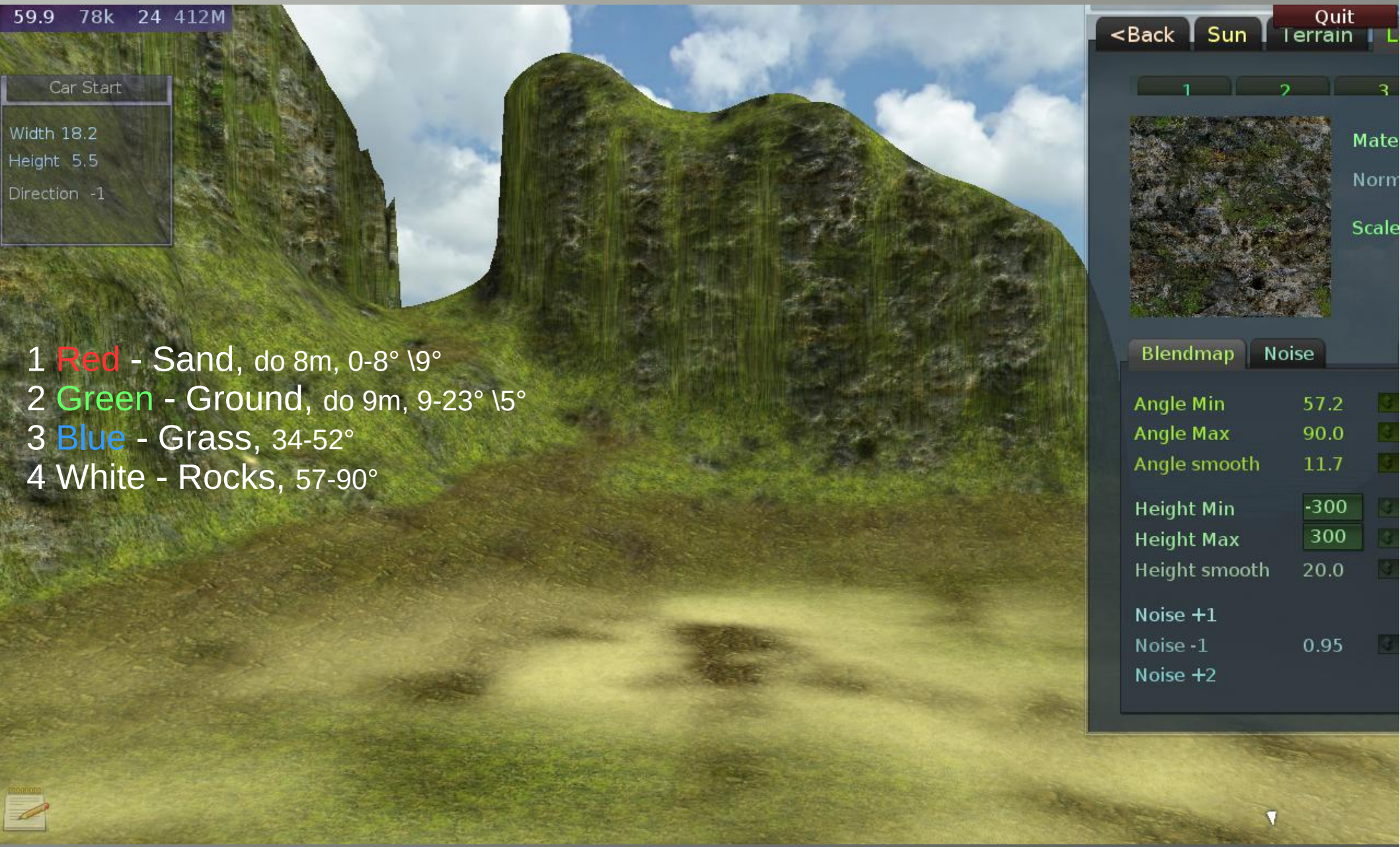
http://opengameart.org/content/terrain-textures-pack-from-stunt-rally-23

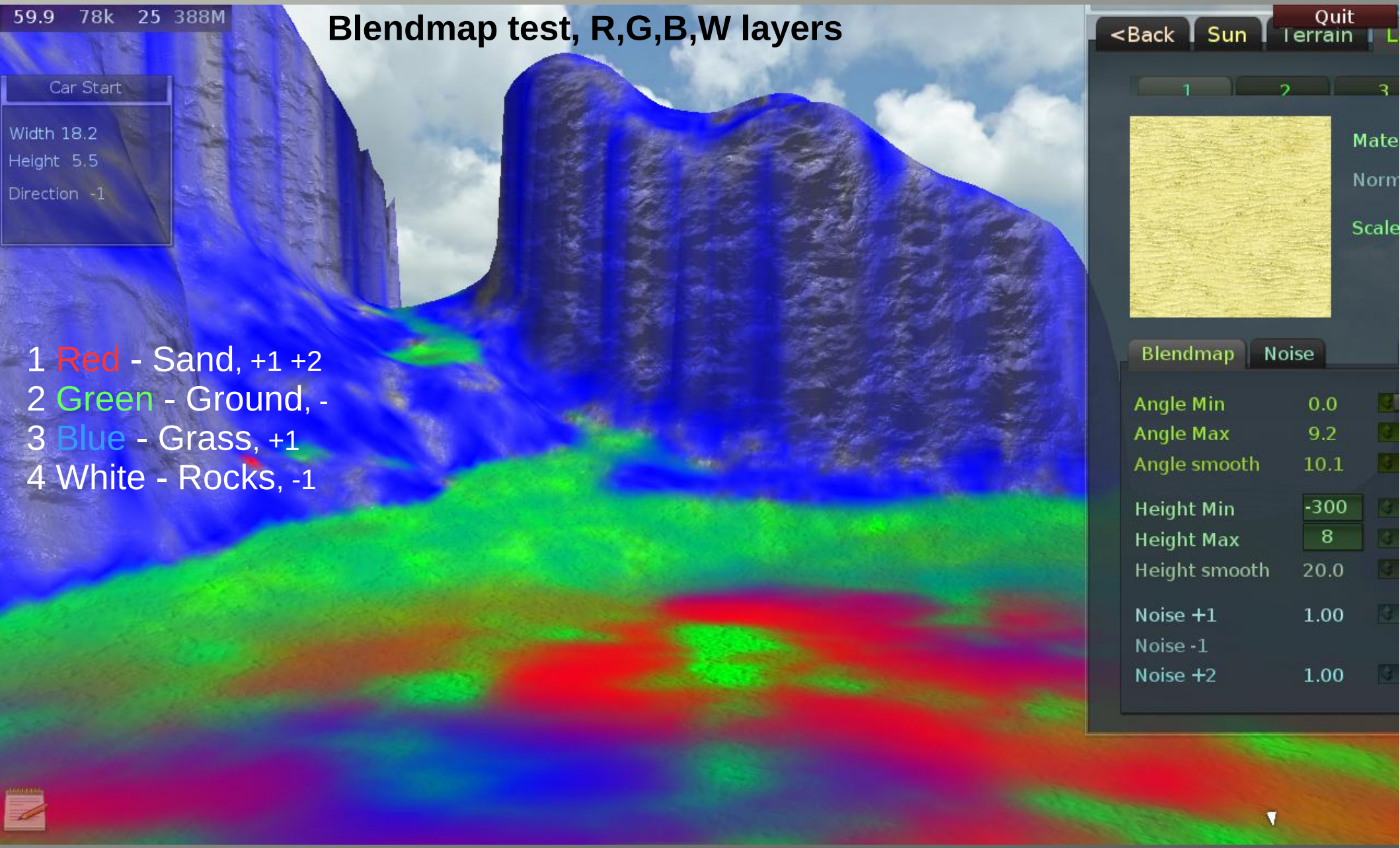

Textures CC0 (FR) – 110,
mainly 1k, many recoloured
Normalmaps (bumps) bottom

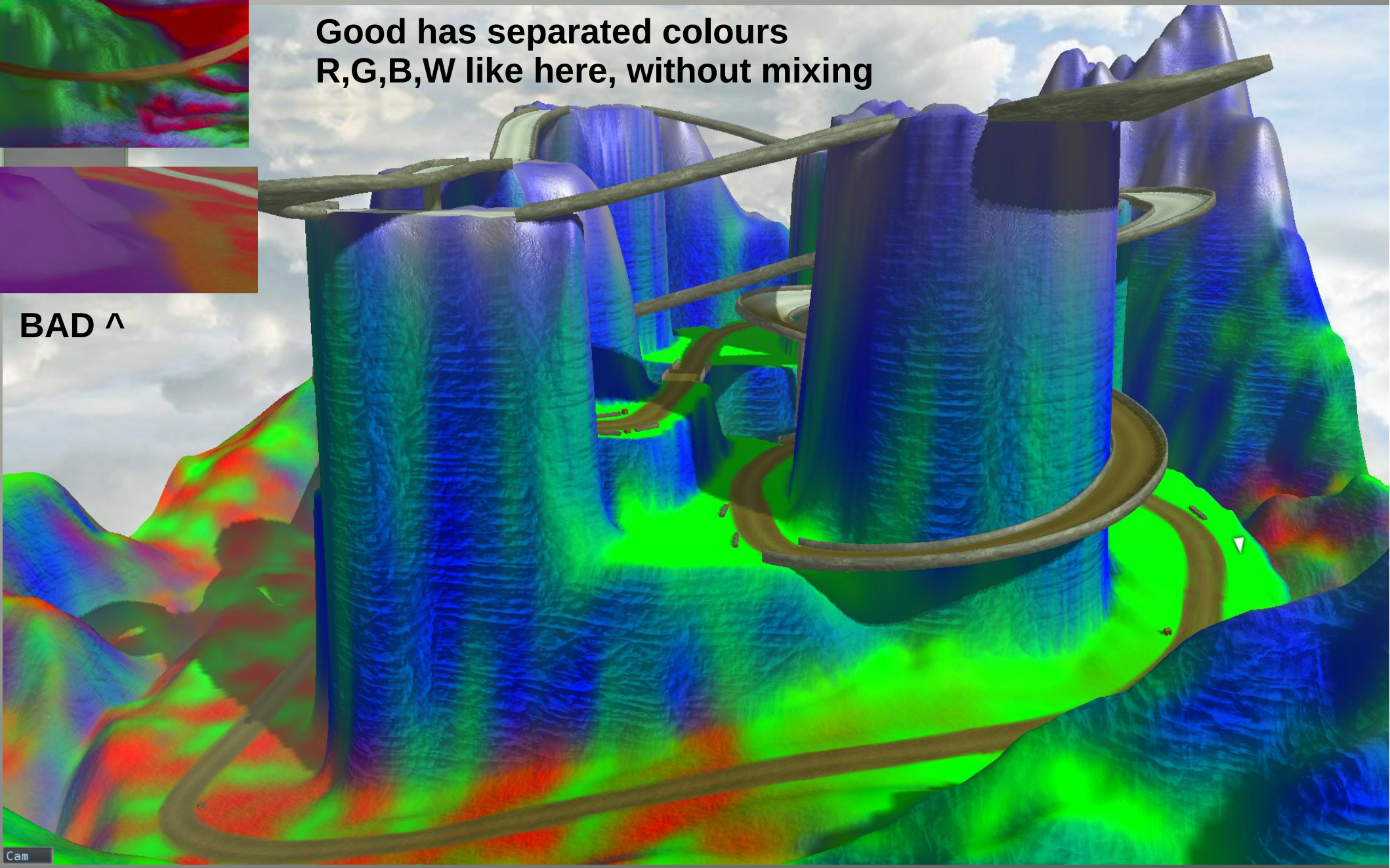
Range where:
terrain **angle** and **height**
and smooth



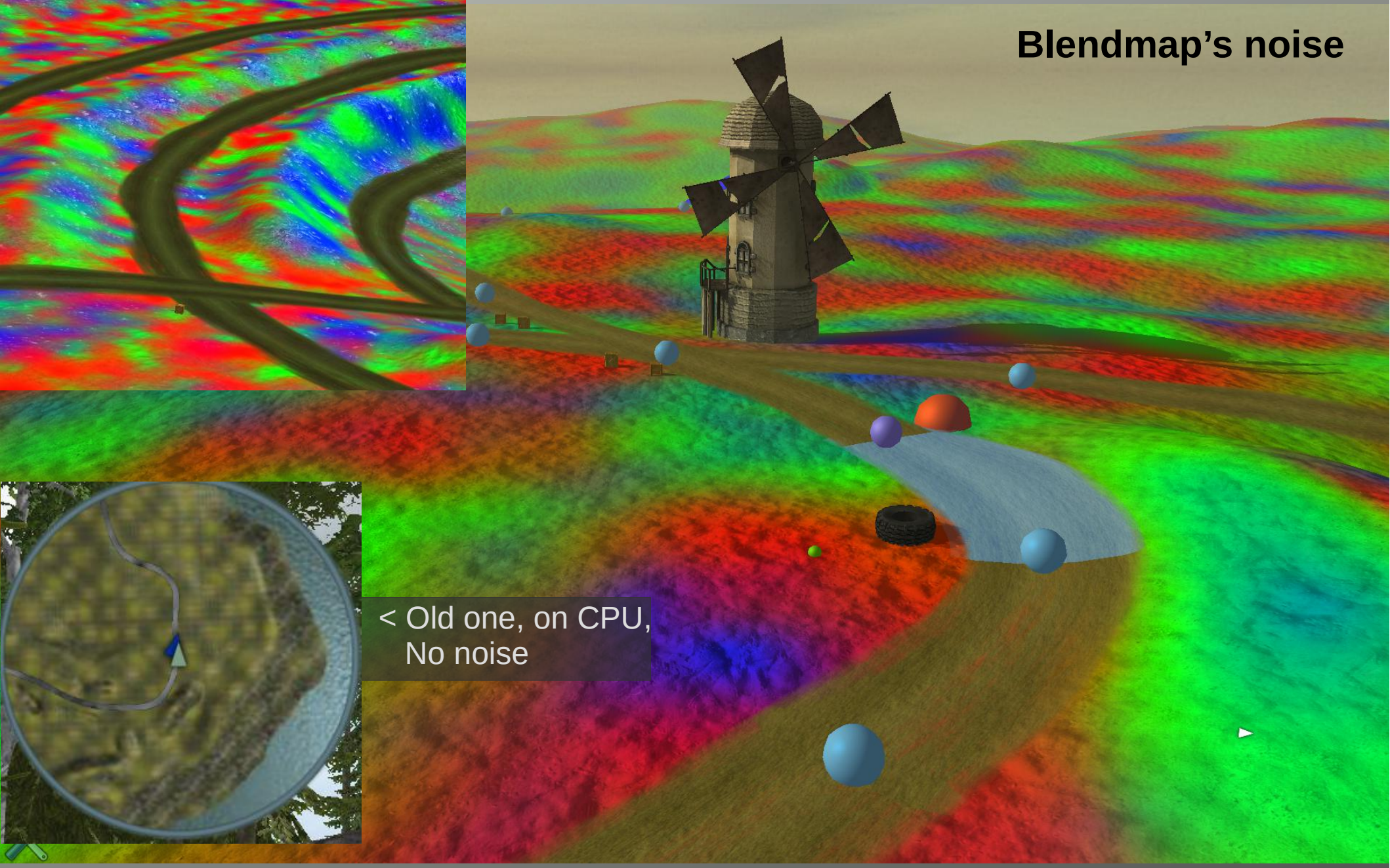
Blending into next / previous layers +1 -1 +2

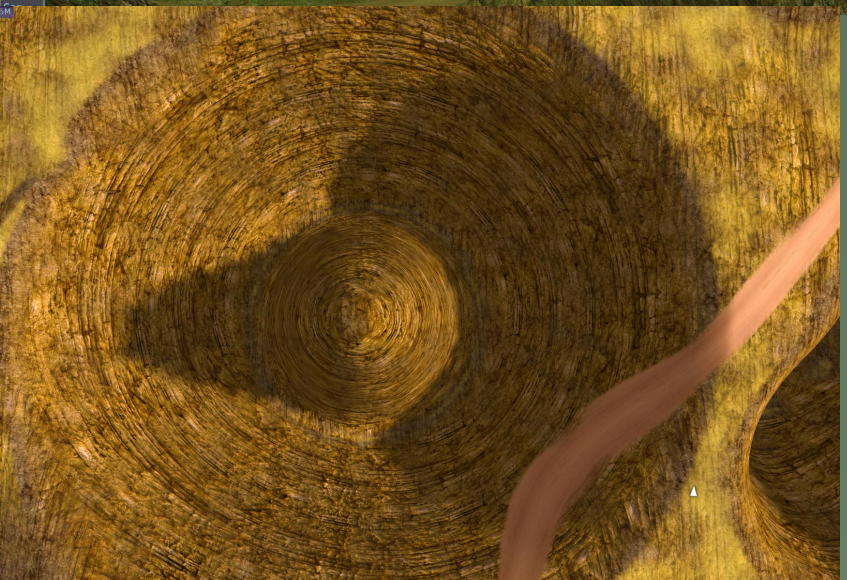

59.9 78k 24 412M
Car Start
Width 18.2
Height 5.5
Direction -1
1 Red - Sand, do 8m, 0-8° \9°
2 Green - Ground, do 9m, 9-23° \5°
3 Blue - Grass, 34-52°
4 White - Rocks, 57-90°
Quit
<Back
Sun
Terrain
1
2
3
Mate
Norm
Scale
Blendmap
Noise
Angle Min 57.2
Angle Max 90.0
Angle smooth 11.7
Height Min -300
Height Max 300
Height smooth 20.0
Noise +1
Noise -1 0.95
Noise +2


Blendmap test, R,G,B,W layers
59.9 78k 25 388M
Car Start
Width 18.2
Height 5.5
Direction -1
1 Red - Sand, +1 +2
2 Green - Ground, -
3 Blue - Grass, +1
4 White - Rocks, -1
Quit
<Back
Sun
Terrain
1
2
3
Blendmap
Noise
Angle Min 0.0
Angle Max 9.2
Angle smooth 10.1
Height Min -300
Height Max 8
Height smooth 20.0
Noise +1 1.00
Noise -1
Noise +2 1.00


Good has separated colours
R,G,B,W like here, without mixing
BAD ^
Cam

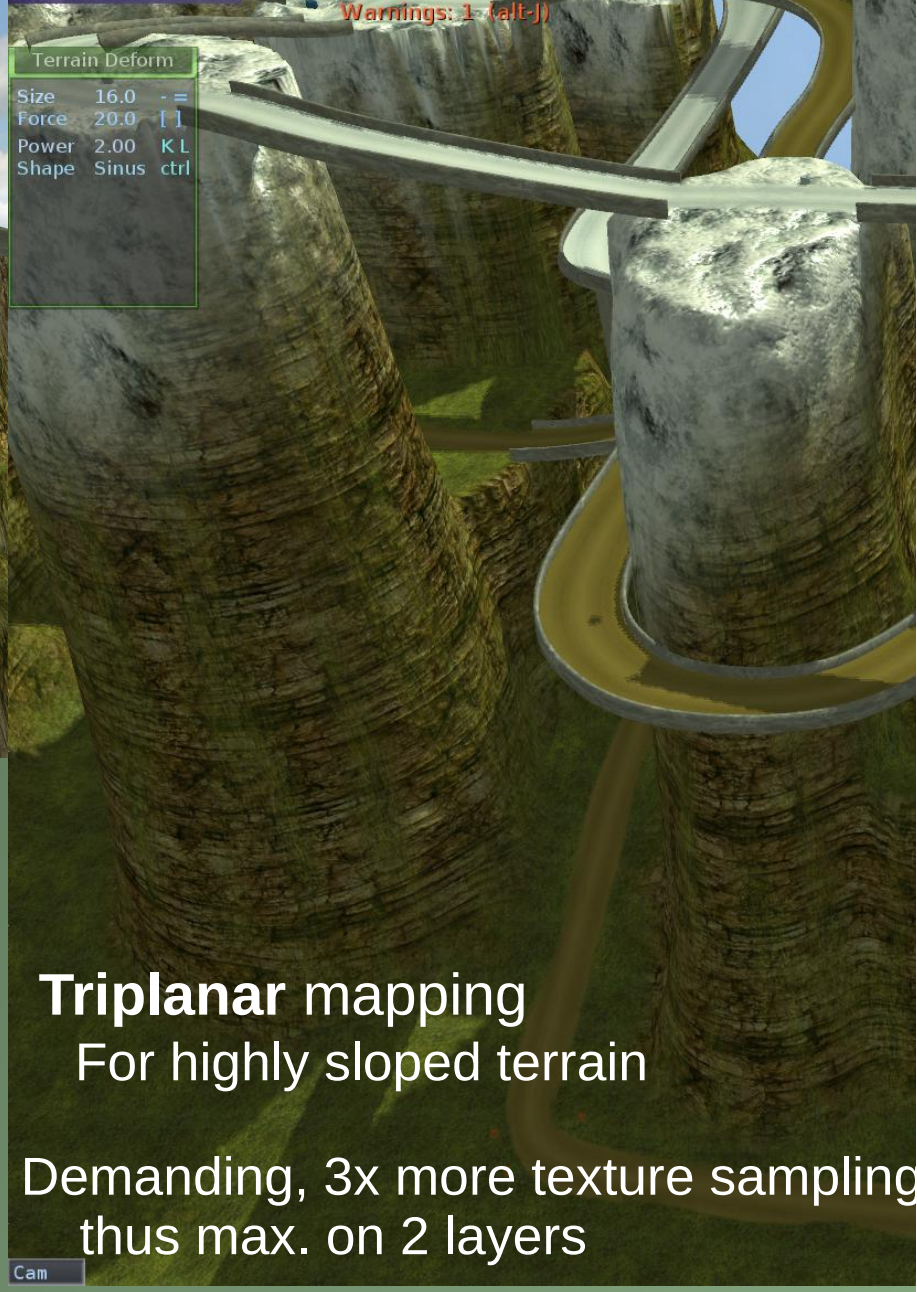
Quit
Height
Size 64.0 - =
Force 20.0 [ ]
Power 2.00 K L
Shape Sinus ctrl
Height 20.0 RMB
Curr.H 78.4
Editor
<Back
Sun
Terrain
Layers
Grasses
Vegetation
Surface
Road
Objects
1
2
3
4
5
6
Material
mntn_brown
Enabled
Used: 4
Normal
mntn_brown_n.jpg
Auto
Scale
32.19
Texture tiling length (less means more repeats).
Highest slopes
Used: 2
Update
Test F9
Blendmap
Noise
Freq. zoom 24.7
Octaves 3
Persistance nois 0.300
Power (shape) 1.50
Noise +1, -1
0 1 2 3 4
5 6 7 8 9
A B C D E
Random
Freq. zoom 34.5
Octaves 3
Persistance nois 0.400
Power (shape) 1.20
Noise +2
Swap
Noise parameters


Blendmap's noise
< Old one, on CPU,
No noise



^ without
with >

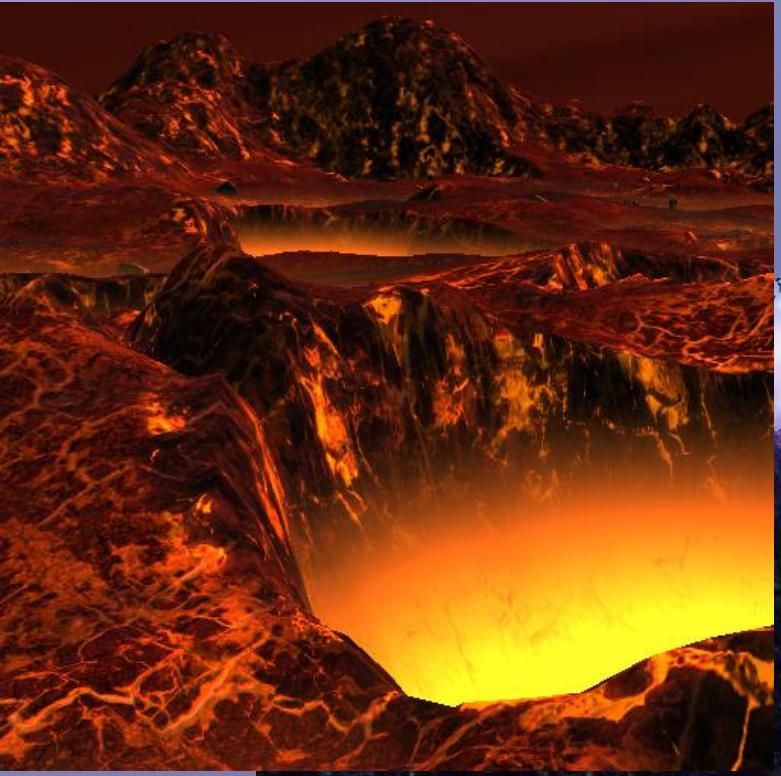
< from top

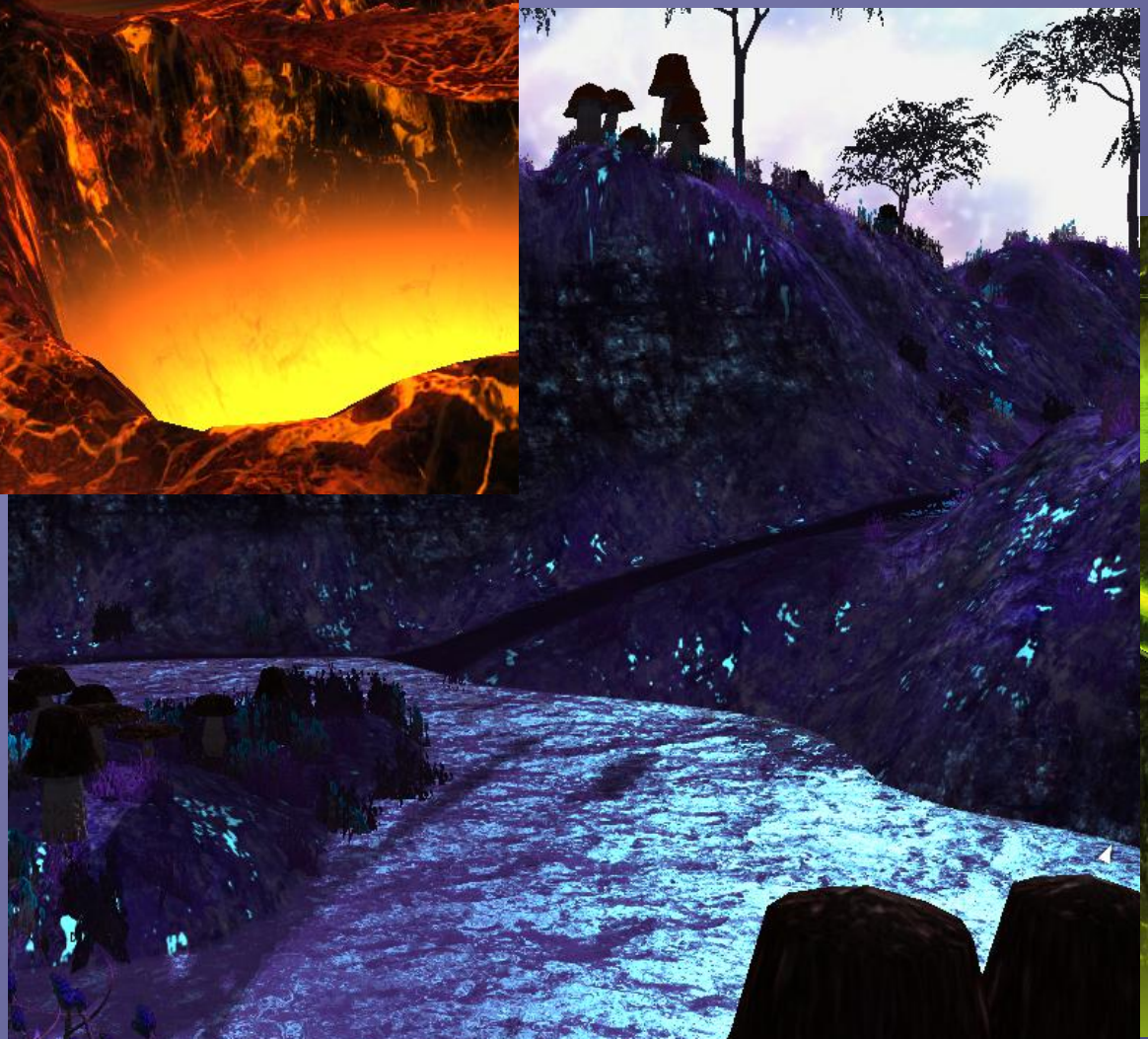


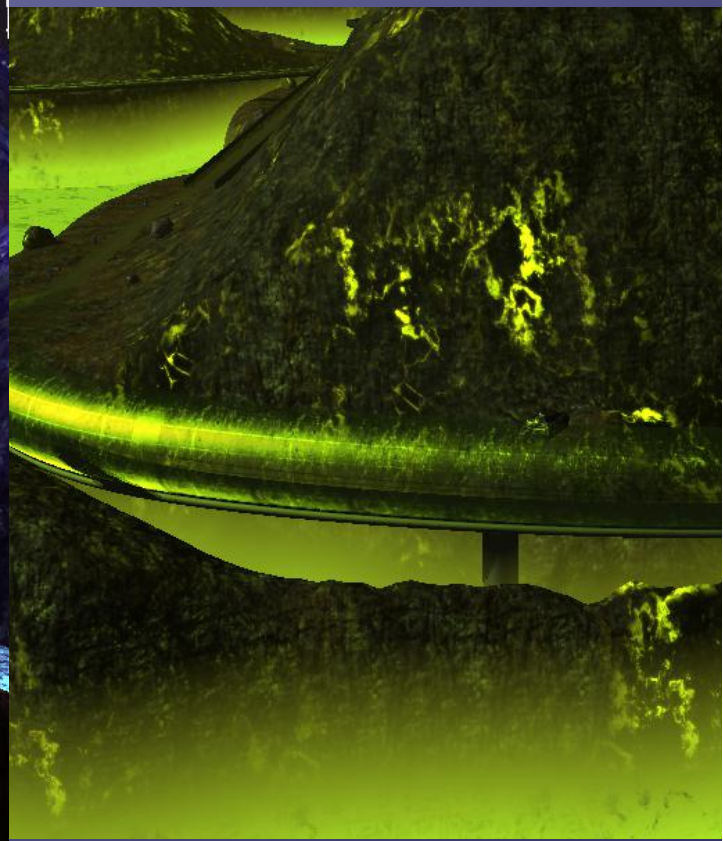
Triplanar mapping
For highly sloped terrain

Demanding, 3x more texture sampling
thus max. on 2 layers

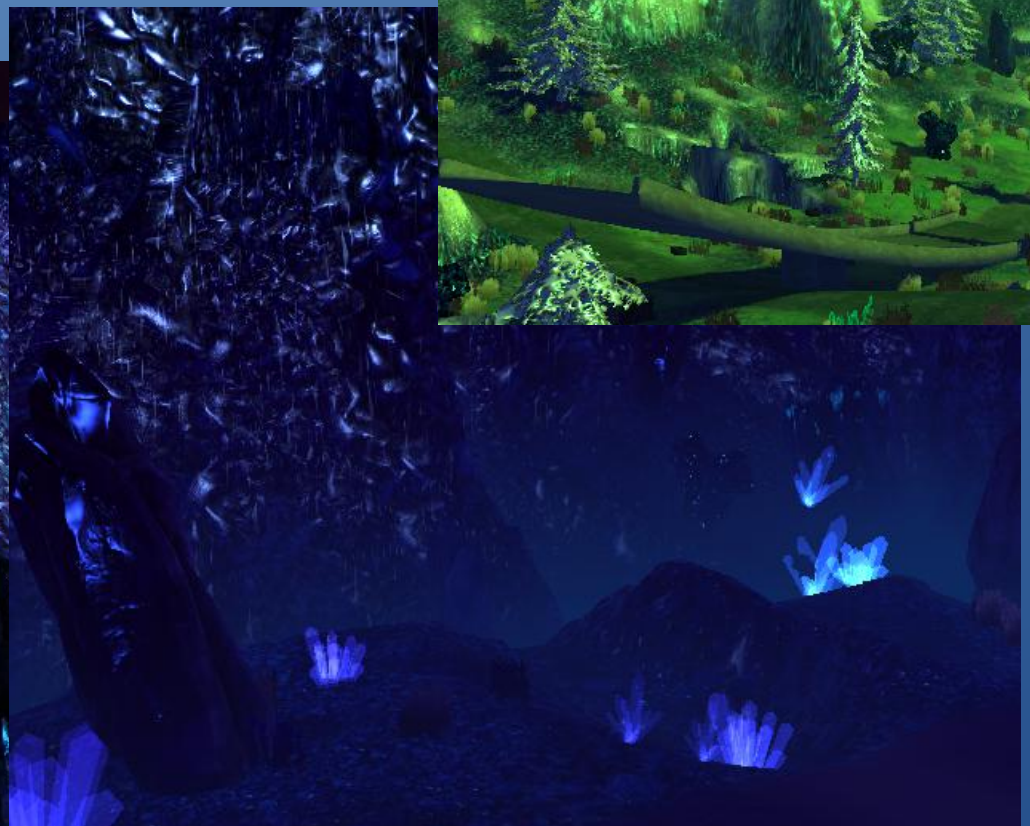
Emissive (luminous) terrains
- instead of specular

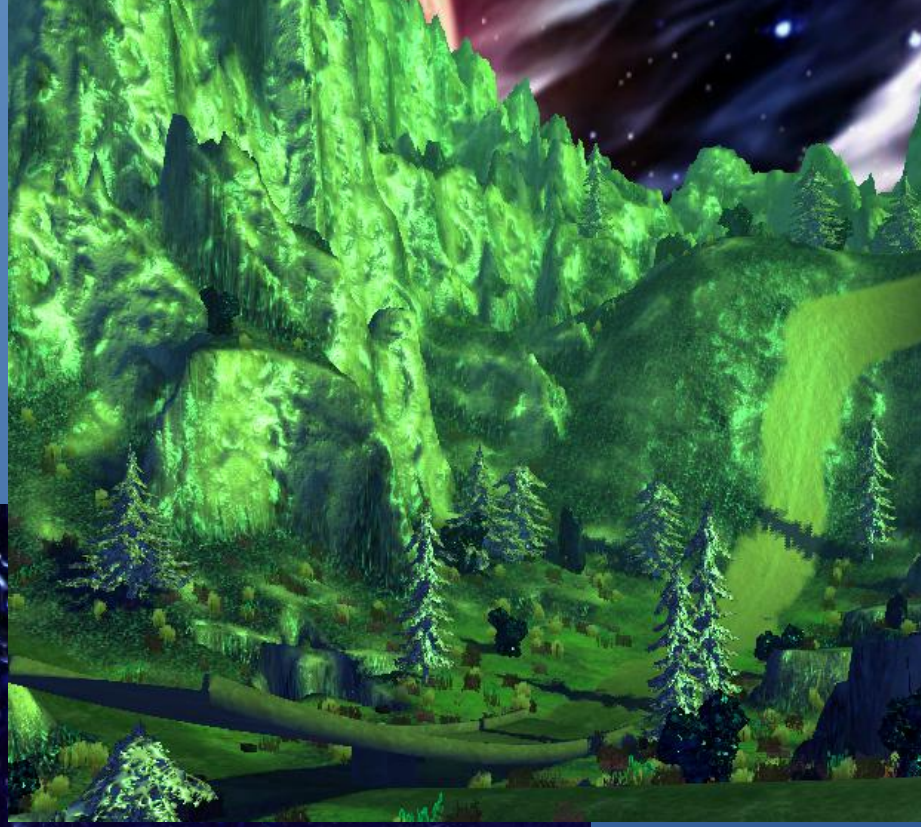






Terrains with high **specular** (none in shadows, where emissive would still light)





Vegetation
Grasses

Vegetation

PagedGeometry, 2006 :(eats CPU, RAM, causes lag, etc.
System for LOD, decreases batches and triangle counts on scene.

Grasses and Models have own page sizes (square) on terrain, about 100-200m. Both have wind, but differently.

Grasses – density, on texture made by editor.
Road excluded and smoothed transition to it.

Models – positions, rotations, scale saved in memory, sparingly, geometry created by CPU at the time of page showing up.
Small page gives less batches. Bigger page has more triangles and lag.

Today Hardware Instancing, by GPU, and grasses probably with Geometry shader.

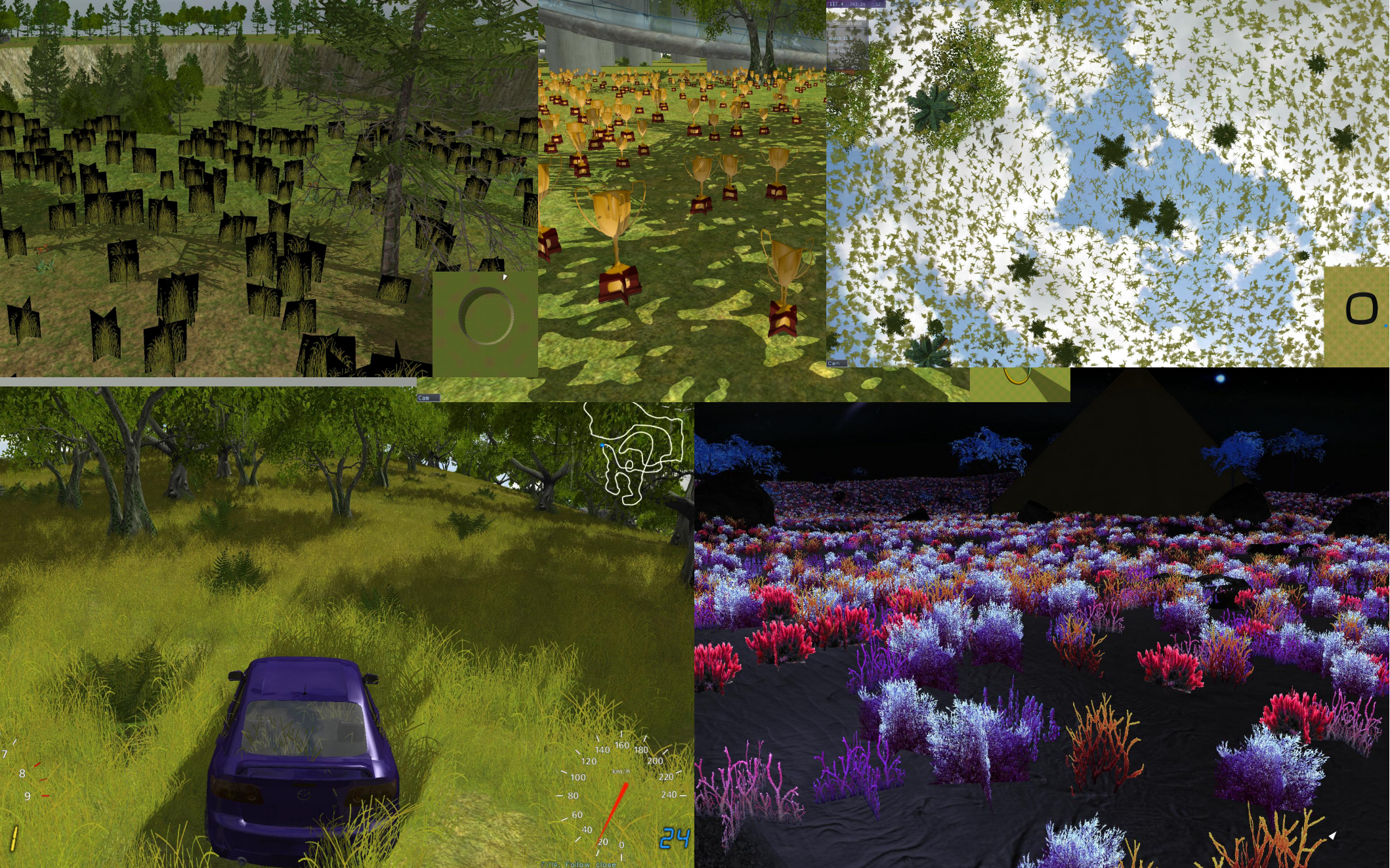
Grasses

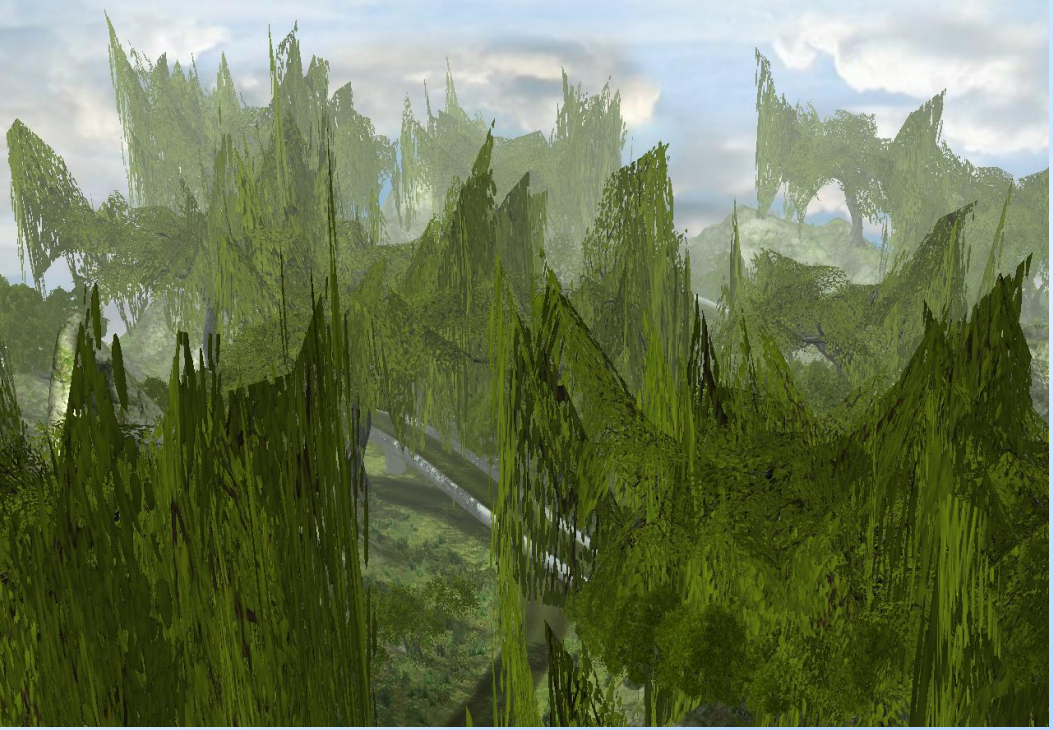
Doesn't slow down car,
but bends under it (vertex shader)

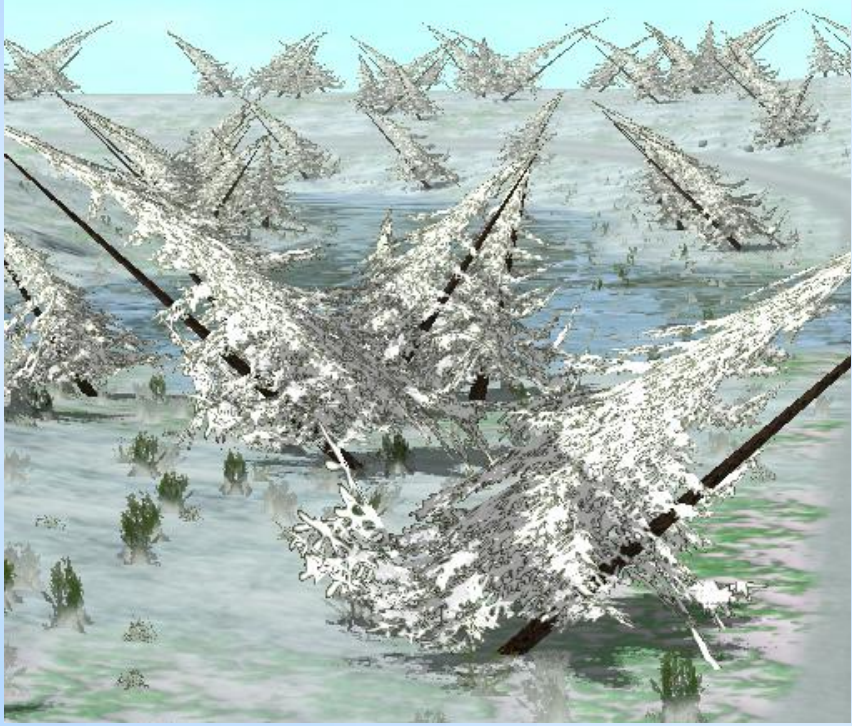
Density,
wind (sway),
distance to road (smooth)

and page size, visibility distance
(optimizations)

Quit
Road Point
Height 22.1 Home
Width 6.00 / *
Roll -8.9 1 2
Pipe O P
Column 0 End
0 roadSavannah 9 0
ChkR K L
50/118
Tab - close/open pick window
. Set parameters, marked wi
Material
S grass12s
S grass12w
F grass12y-
F grass15
| grass15g
O grass15o
| grass16g
A grass16r
S grass16s
F grass17
A grass17r
| grass18gw
S grass18s
W grass18w
W grass18wg
F grass19
S grass2
S grass2g
C grass20
A grass20p
| grass3
| grass3g
O grass3o
S grass3s
G grass3y
D grass4v
D grass5
A grass6r
C grass6s
W grass7wg
W grass7wy
M grass8g
F grass9r
C grassAustralia
D grassDesert
E grassForest
G grassGreece
S grassJungle
D grassSavanna
W grassWinter
X grassUnidentifiec
X grassX10b
X grassX13p
X grassXc
X grassXv
L grass4v-alien
L grassX10b-alien
L grassXc-alien
Z grassZ10
<Back
Sun
Terrain
Layers
Grasses
Road
Objects
Properties
Grasses
Channels
1 2 3 4
Material grass3s
Enabled
Used: 5
Color map grClrJungle2.png
Density 0.077
Size
.min x 1.49
.max x 2.02
.min y 1.62
.max y 2.42
Channel 0
Sizes, layers,
Pick list


Cam
Cam
km/h
24
2/14. Follow close





Vegetation: Models

Trees, pines, palms, rocks, ferns, plants, big mushrooms, crystals, etc.

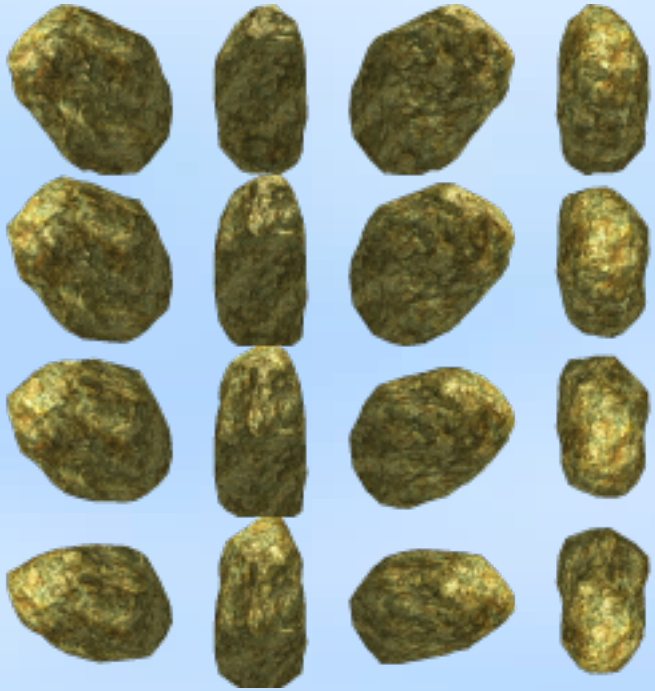
No bushes though, since bad self shadow, shadow caster material has no wind in vertex shader.

2 Textures of auto generated **impostors**:

Size **1k**, **png** because it's transparent
4 **angles** yaw (columns) and 4 pitch (rows)

Tree:

Rock:



1 impostor:

Impostors have static lighting (rather can't be dynamic), hence bad specular,
Visible angle switching (only 4), are ugly/blurred for tall pines.

But **benefit**: 2 triangles instead of 300-1k (max 5k) for whole model.

Density,
distance to road (common),
page, distance,
and since where impostors are used

Density, Scale - Auto placement on terrain, range: height, angle, distance to road (min, max), depth in fluids, wind amount

Track examples with good vegetation

Jungle

Savannah

Finland

Moss (Jungle)

Unidentified

Winter

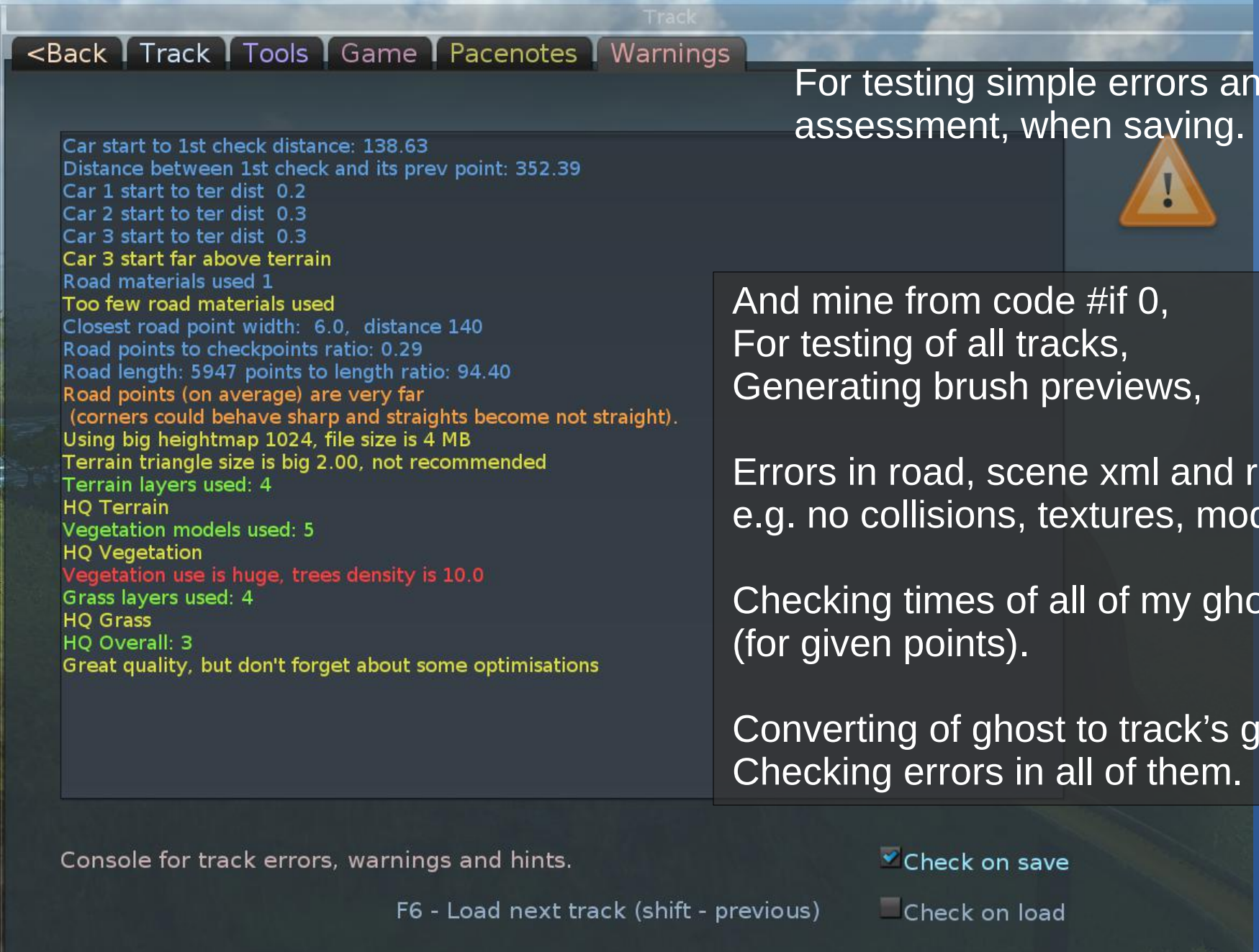
Editor Tools

Tools:

Copying settings from other track (scenery)

Scaling track, terrain

Deleting



For testing simple errors and basic quality assessment, when saving.

And mine from code #if 0,
For testing of all tracks,
Generating brush previews,

Errors in road, scene xml and resaving,
e.g. no collisions, textures, models etc.

Checking times of all of my ghosts
(for given points).

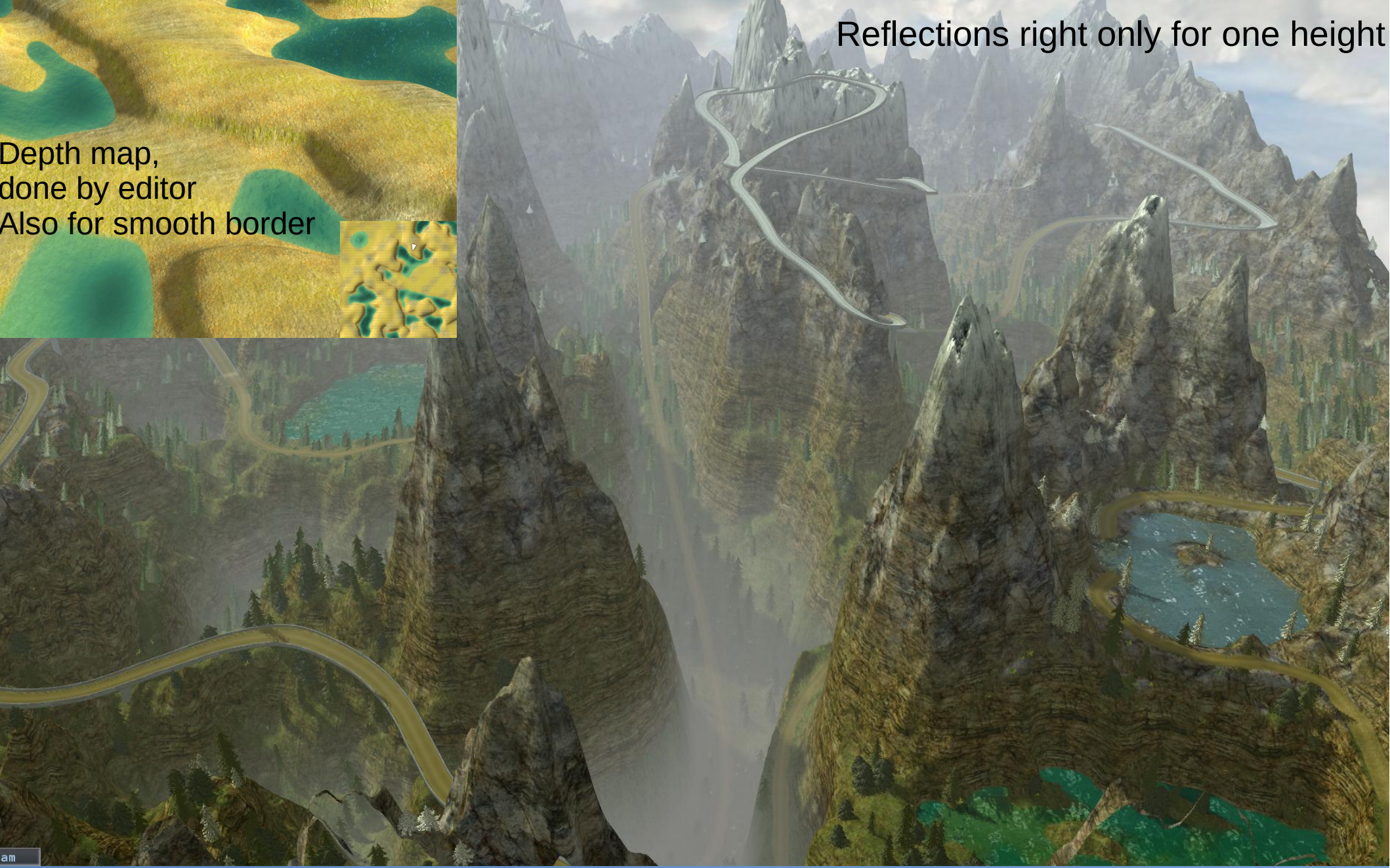
Converting of ghost to track's ghost.
Checking errors in all of them.

Fluids

Water, mud,
alien, acid, lava,
solid lava, ice.

Old, looked poorly

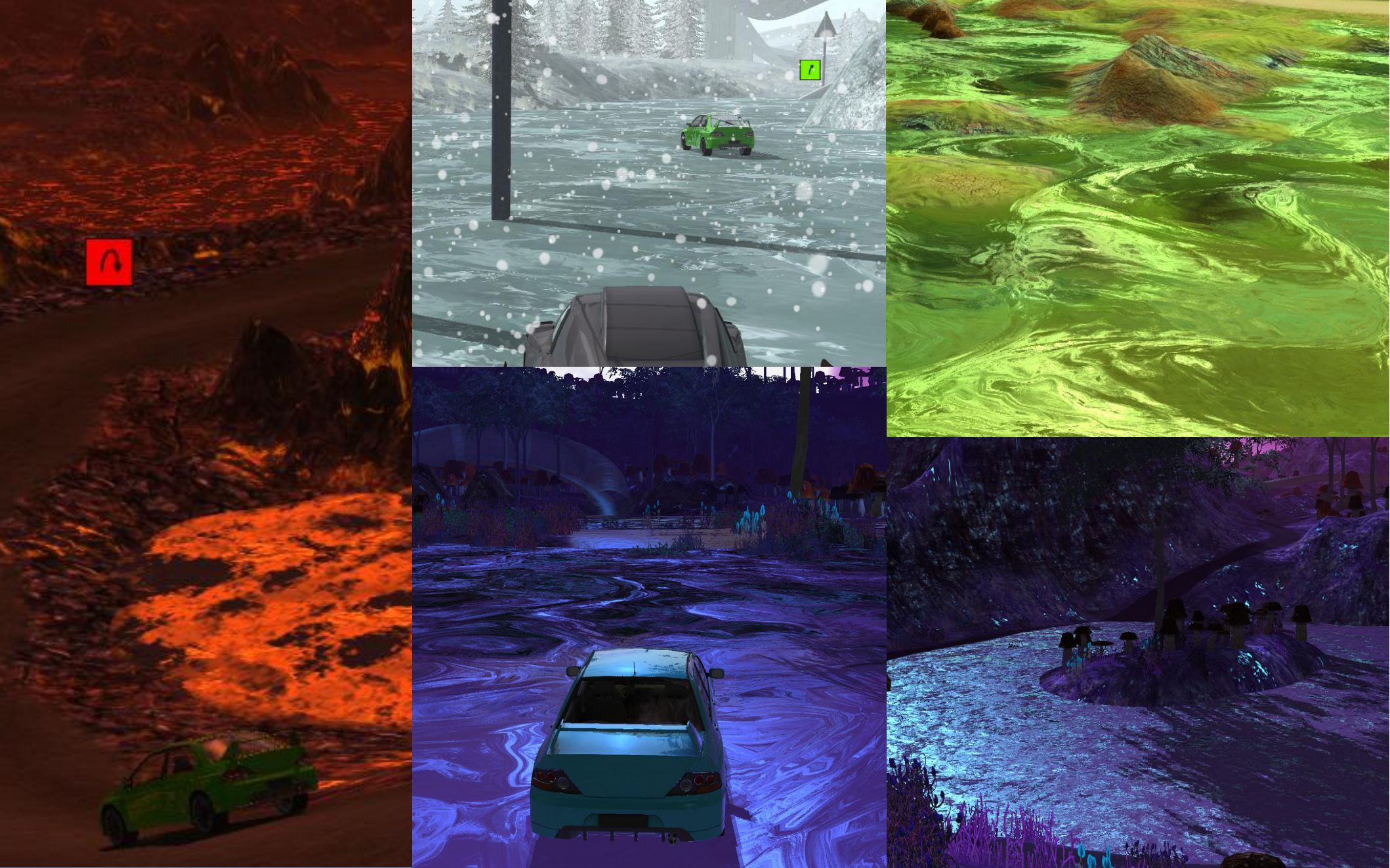
Fluids are added and edited
as boxes in editor,
without rotation, a bit limiting.


Reflections right only for one height
Depth map,
done by editor
Also for smooth border

< Refraction Mud >

Underwater Fog

Wheel spheres only for depth ^ submerge.
Force from angular velocity, damping. 3 types of mud: slippery, dense, etc.



Materials

Materials

Shiny generator - *scrawl* wrote during development,
few other projects used it too.
Parses its own files and generates shaders in GLSL or HLSL,
when needed, for given set of options (#if-s).

Simple, nice files **.mat** with parameters, default values,
e.g. colours, textures, inheriting, other extras: reflection, fresnel.

Files **.shader**, code for GPU - style like in and converted to GLSL/HLSL,
with #ifdef's makes the combination which is needed,
own parameters and textures (auto assigning samplers).

Few primary: main, terrain, water,
and many tiny ones for cursors etc.

And other files .shaderset for some configuration.

Materials .mat

```
material XZ_wheel
{
    parent car_base
    diffuseMap XZ_Tire.png
    normalMap XZ_Tire_norm.png
    specMap XZ_Tire_spec.png
    reflMap XZ_Tire_refl.png
    ambient 0.4 0.4 0.4
    diffuse 0.4 0.4 0.4
    specular 1 1 1 4
    env_map true
    fresnel true
    fresnelScaleBiasPower 0.6 0.15 4
}
```

```
pass
{
    vertex_program angles_vertex
    fragment_program angles_fragment

    shader_properties
    {
        InvTerSize  $InvTerSize
        TriSize     $TriSize
    }
    texture_unit samHMap
    {
        texture HmapTex
        tex_address_mode clamp
    }
    ...
}
...
```

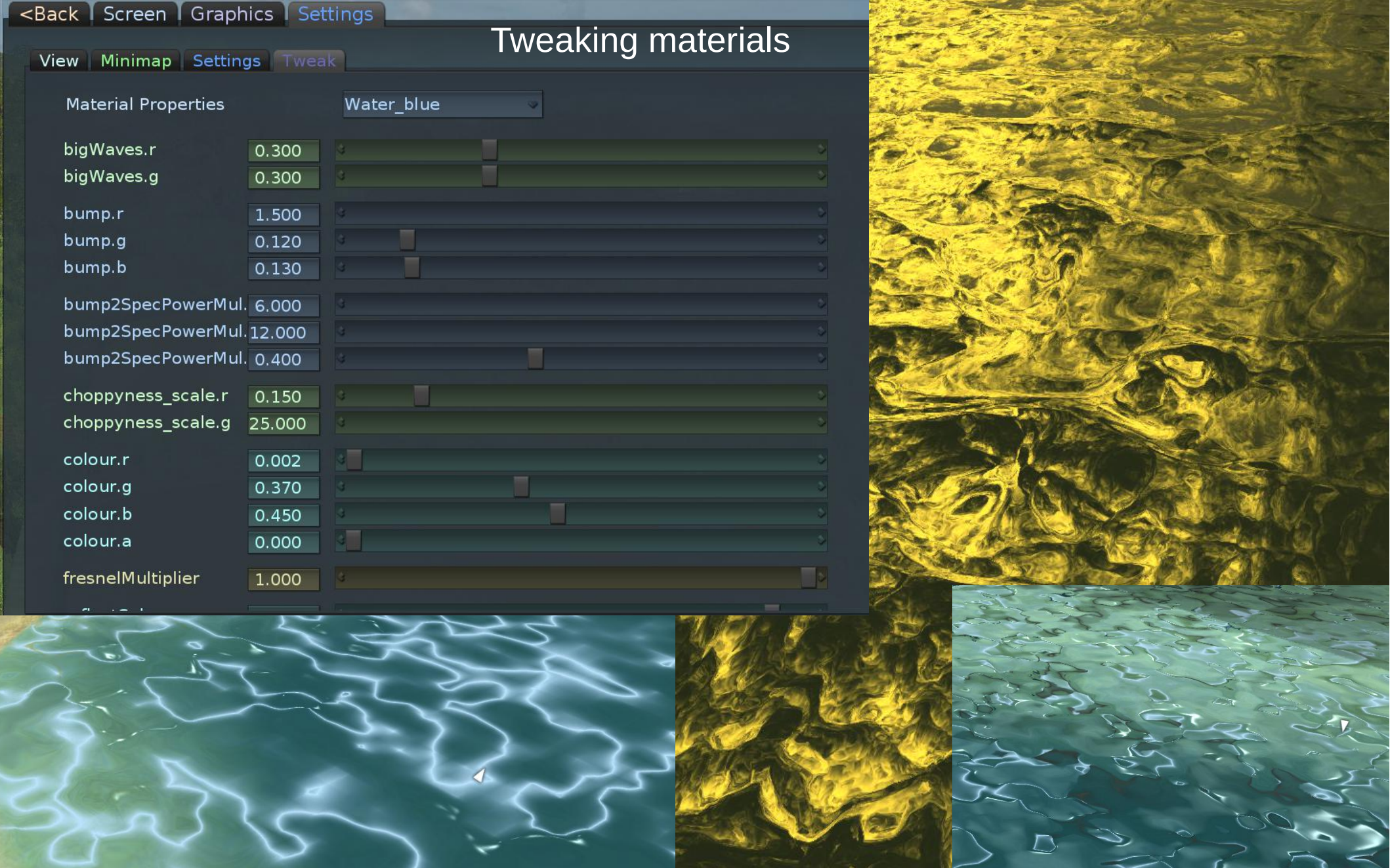
Glass pipe – 2 passes

blend (add, alpha), transparent, depth_write, bias,
shadows false, cull, alpha_rejection,
Extra: tree,grass wind, twoside, bump_scale, car gloss, ...

Materials .shader - snippets

```
#if FOG
        shUniform(float4, fogParams)  @shAutoConstant(fogParams, fog_params)
        shUniform(float4, fogColorSun)   @shSharedParameter(fogColorSun)
...
#if SHADOWS
         @shForeach(3)
                shInput(float4, lightSpacePos@shIterator)
                shSampler2D(shadowMap@shIterator)
         @shEndForeach
#endif
...
        SH_START_PROGRAM
        {
                shOutputColour(0) = shSample(diffuseMap, UV.xy);
...
#if ENV_MAP
                float3 r = reflect( -eyeDir, normal );
                r = normalize(shMatrixMult(worldMatrix, float4(r, 0)).xyz);
...
#if ALPHA_MAP
                shOutputColour(0).a *= shSample(alphaMap, float2(UV.x, UV.y * 0.025)).r;
```

Tweaking materials



Simulation

Simulation

Has 2 mode: **Easy** (less slippery road, more inertia, slower vehicles) and **Normal**. Hard started by me and abandoned (after 3 months), hence so many graphs, visualisations and editors in game. Uses double types.

Frequencies [Hz] Fps, computations per second (arcades have 60 for all):
bullet_freq = **160** - more means smoother, but bit more CPU for many objects
bullet_iter = 24
dynamics_iter = **60** - iterations per bullet frame, so *bullet_freq = 9600 Fps! (was less)
suspension (big jumps and stiffness), torques wheel, engine, contacts interpolated
game_freq = 82 - input, timer

Second **thread** is for simulation, bullet and cameras.
Data exchange in constant size buffer and only incremented index.
No need for synchronization. No interpolation of positions etc. for GPU dt.

Spaceships cast 2 rays.
Not 4 like cars hence they don't fly in pipes and go nuts.
Suspended above ground (suspension). Sphere very easily.

Vehicles List

Names are 2-3 letters (trademark)

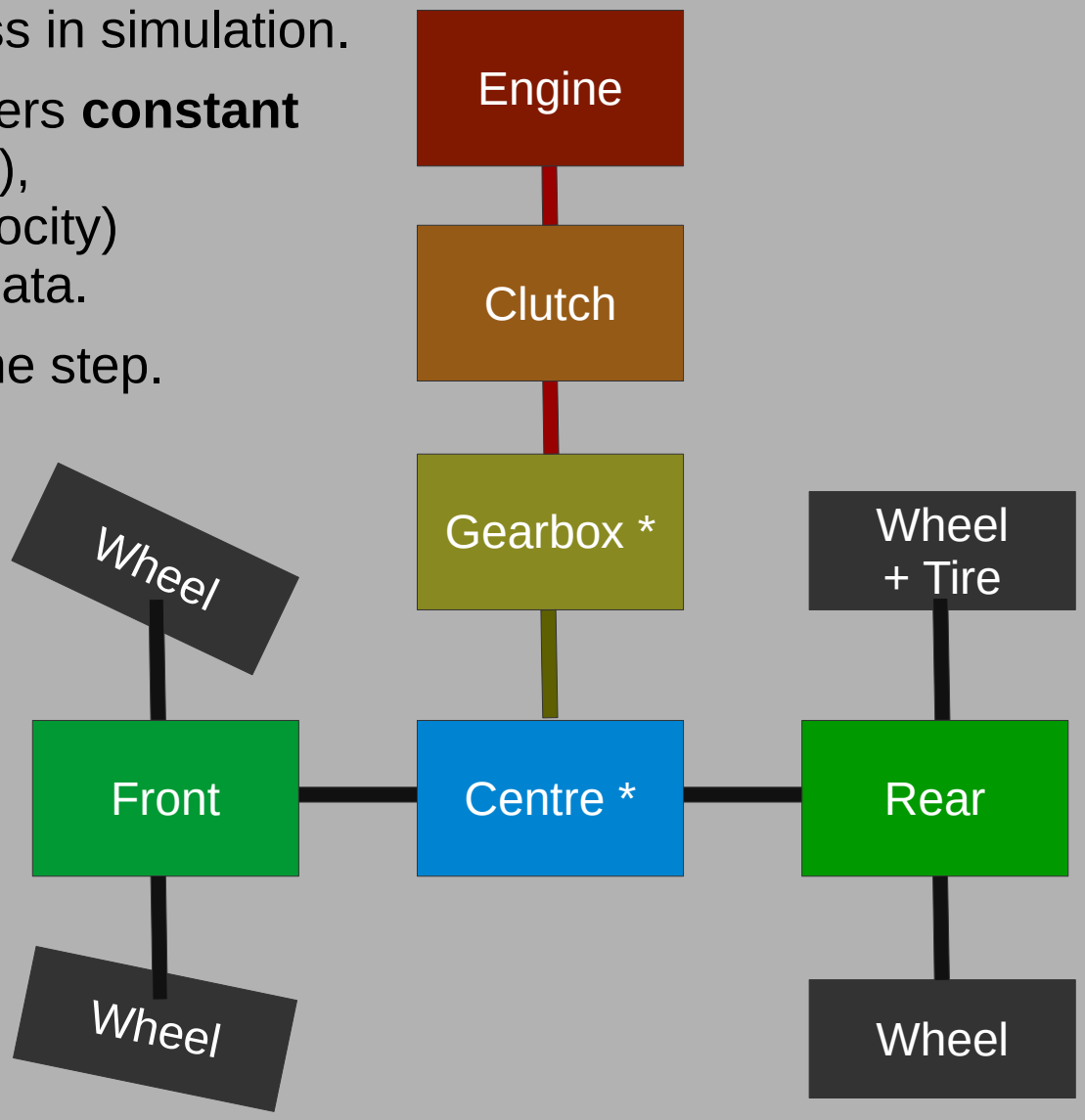
Speed, Year, Type

Results from simulation of Performance Test

Each box is a class in simulation.

Has own parameters **constant** (e.g. inertia, mass), **state** (angular velocity) input and output data.

Simulated with time step.



Aero-dynamics

+ Brake
+ Suspension

3 LSD > Limited Slip Differential

Handbrake only rear

Anti-roll bar – stiff bar connecting left and right suspensions

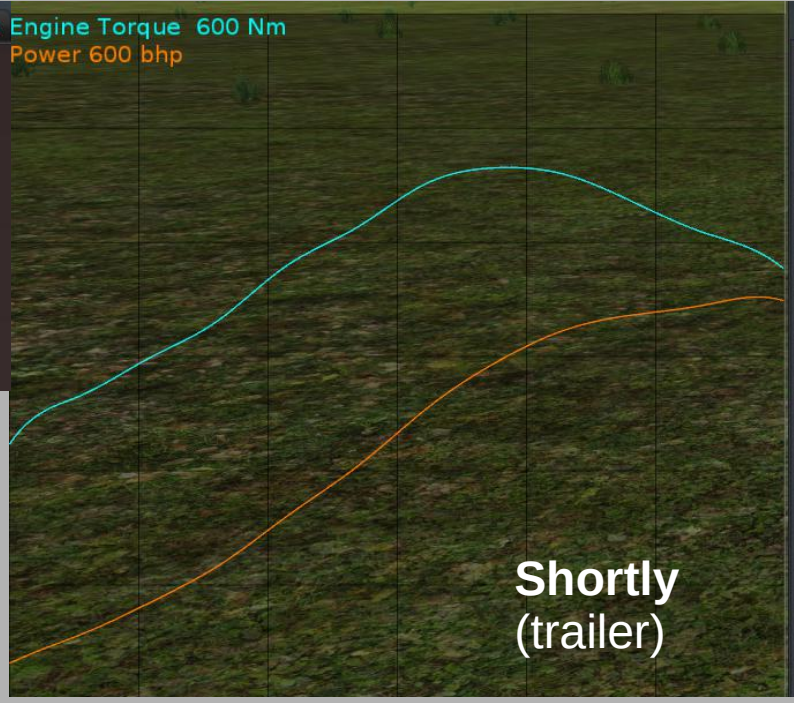
Surface

* have ratio (not 1:1)

st c e, t, g ss

```
# engine
#---------------------------
[ engine ]
sound = engine
position = 0.0, 0.4, 0.3
mass = 240.0
rpm-limit = 6600
inertia = 0.26
start-rpm = 1000
stall-rpm = 400
fuel-consumption = 1e-9
friction = 230
```

Engine



Shortly
(trailer)

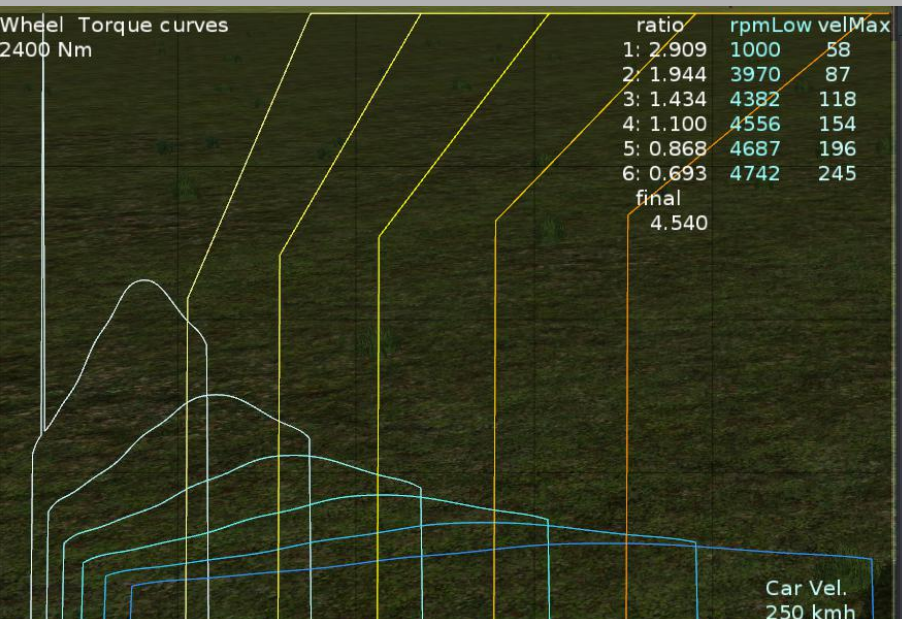
st c e, t, g ss ti

```
torque-val-mul = 1.10
torque-curve-00 = 1000, 203
torque-curve-01 = 1500, 241
torque-curve-02 = 2000, 271
torque-curve-03 = 2500, 301
torque-curve-04 = 3000, 345
torque-curve-05 = 3500, 375
torque-curve-06 = 4000, 410
torque-curve-07 = 4500, 423
torque-curve-08 = 5000, 418
torque-curve-09 = 5500, 396
torque-curve-10 = 6000, 372
torque-curve-11 = 6500, 350
torque-curve-12 = 7000, 303
torque-curve-13 = 8000, 259
real-pow-tq-mul = 1.2

[ clutch ]
max-torque-mul = 1.1
```

st c e, t, g ss ti bi a

```
# aerodynamics
#---------------------------
[ drag ]
position = 0.0, 0.0, -0.60
frontal-area = 2.0
drag-coefficient = 0.20

[ wing-front ]
position = 0, 2.34, 0.5
frontal-area = 0.2
drag-coefficient = 0
surface-area = 0.55
lift-coefficient = -4.0
efficiency = 0.95

[ wing-rear ]
position = 0, -2.14, 0.37
frontal-area = 0.2
drag-coefficient = 0
surface-area = 0.58
lift-coefficient = -4.0
efficiency = 0.95
```

Aero-
dynamics

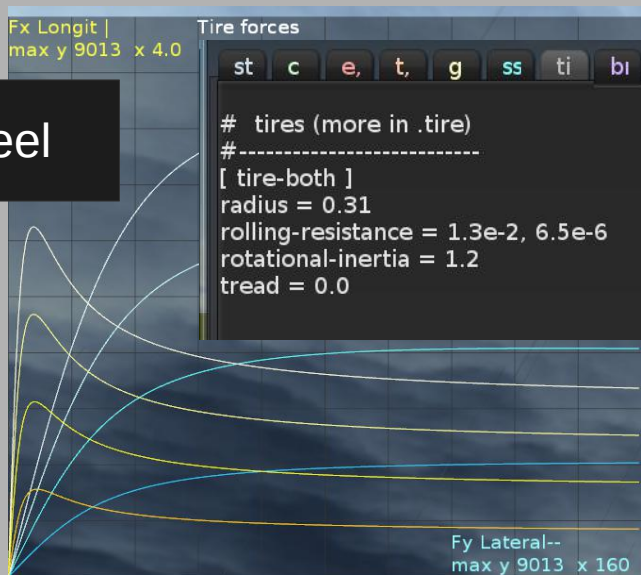


st c e, t, g ss ti

```
# gearbox
#---------------------------
[ transmission ]
gears = 6
gear-ratio-r = -3.2
gear-ratio-1 = 2.909
gear-ratio-2 = 1.944
gear-ratio-3 = 1.434
gear-ratio-4 = 1.1
gear-ratio-5 = 0.868
gear-ratio-6 = 0.693
shift-delay = 0.10

[ differential ]
final-drive = 4.54
anti-slip = 600.0
```

Gearbox

Wheel

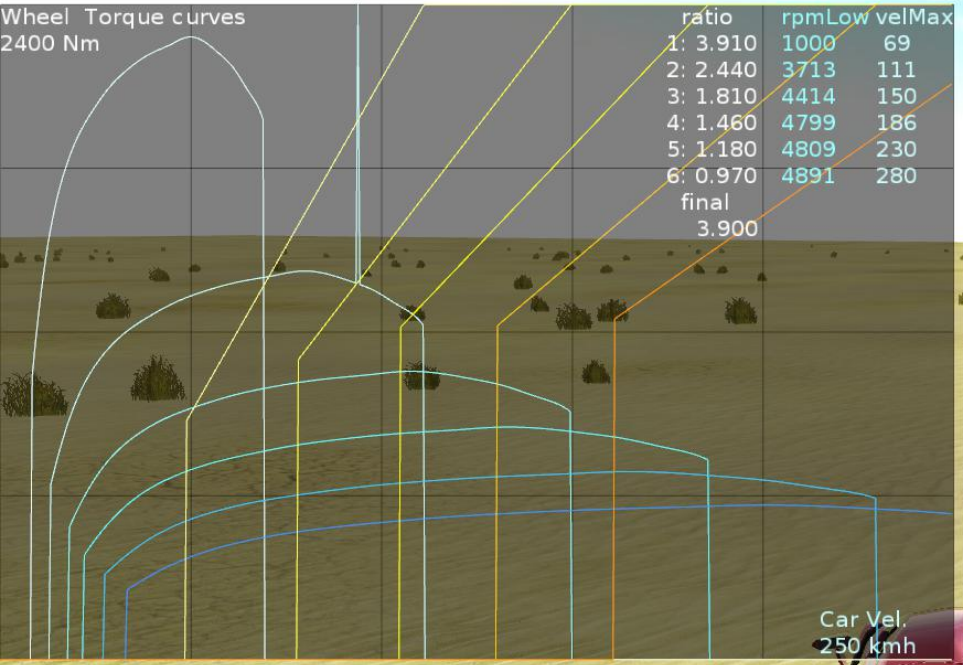


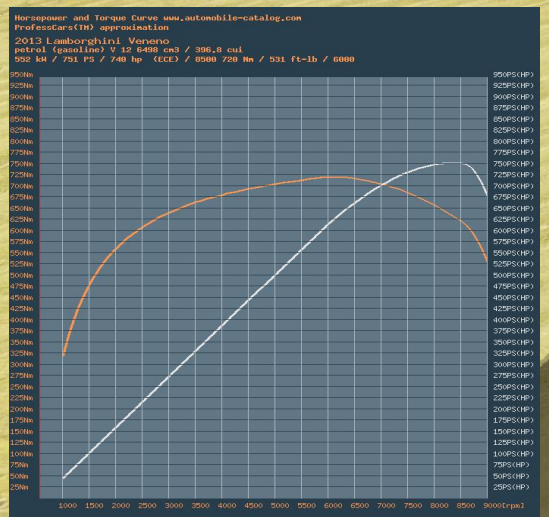
st c e, t, g ss ti bi

```
# tires (more in .tire)
#---------------------------
[ tire-both ]
radius = 0.31
rolling-resistance = 1.3e-2, 6.5e-6
rotational-inertia = 1.2
tread = 0.0
```

Torque curves for gears in game v

Editing vehicle in game, reload





Tweak

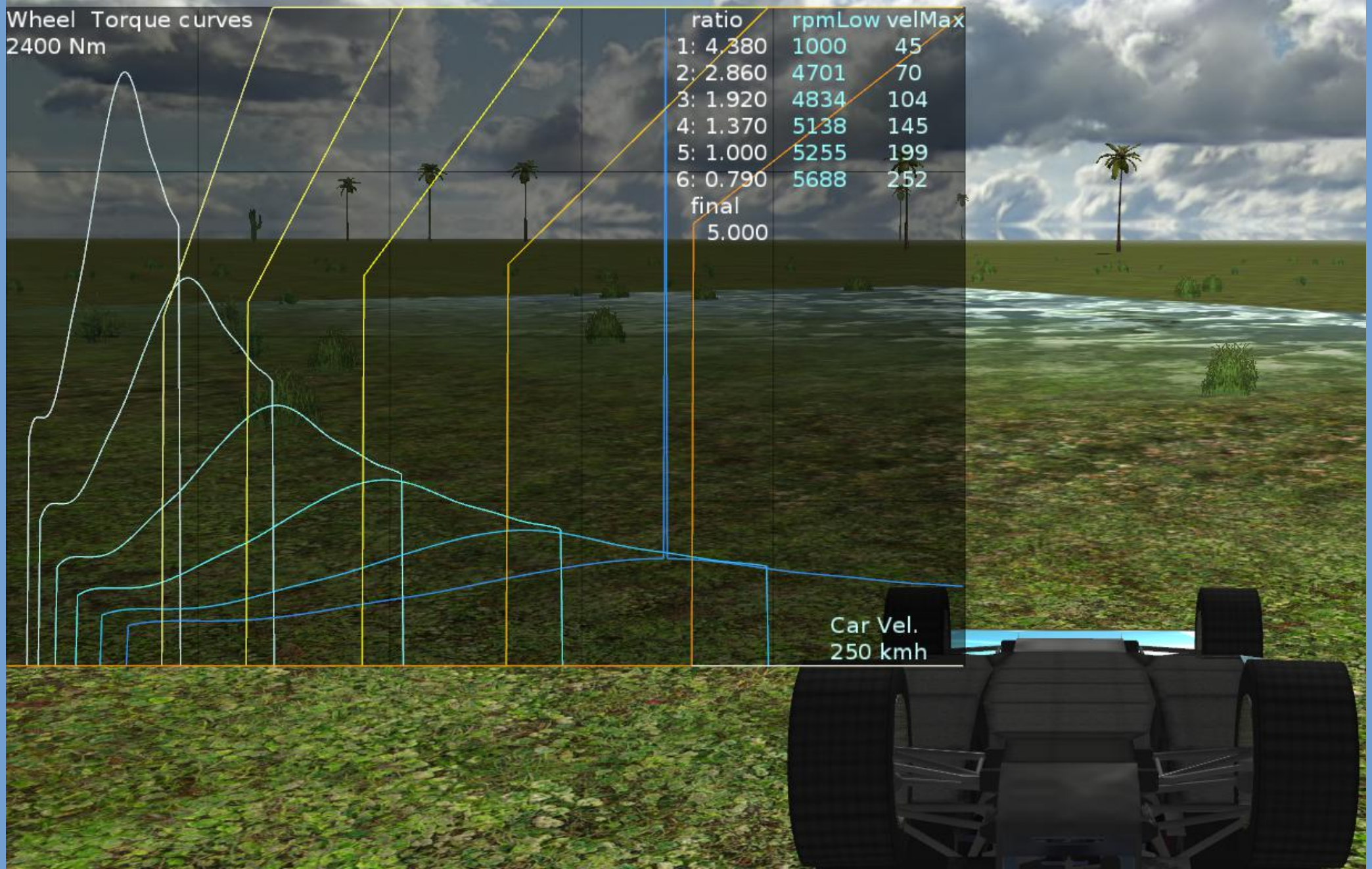
Vehicle | Tires | Surface | VehicleTest | collisions

Original: normal/cars/Y7.car Save

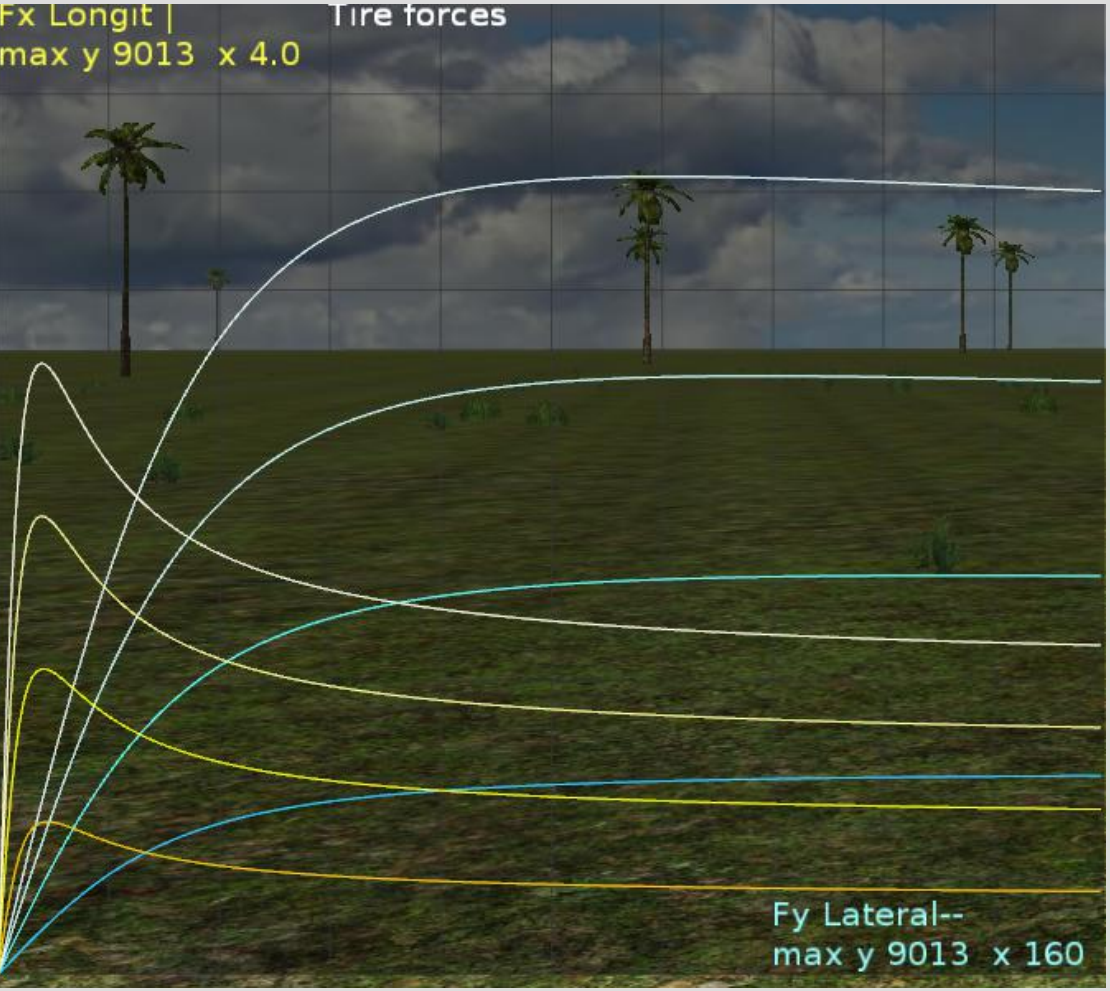
st c e, t, g ss ti bi a .f .r m

```
#  gearbox
#--------------------------
[ transmission ]
gears = 7
gear-ratio-r = -3.71
gear-ratio-1 = 3.91
gear-ratio-2 = 2.44
gear-ratio-3 = 1.81
gear-ratio-4 = 1.46
gear-ratio-5 = 1.18
gear-ratio-6 = 0.97
gear-ratio-7 = 0.84
shift-delay = 0.08

[ differential ]
final-drive = 3.9
anti-slip = 500.0

[ fuel-tank ]
position = -0.02, -0.66, -0.26
capacity = 0.0492
volume = 0.0492
fuel-density = 730.0
```

< This one based on real data


Wheel Torque curves
2400 Nm
ratio rpmLow velMax
1: 4.380 1000 45
2: 2.860 4701 70
3: 1.920 4834 104
4: 1.370 5138 145
5: 1.000 5255 199
6: 0.790 5688 252
final
5.000
Car Vel.
250 kmh

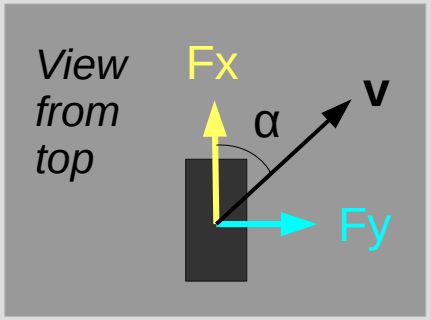
Tires



Yellow: Fx(σ) longitudinal force (drive)
From slip (σ, spinning, division of angular velocity to real movement along wheel direction)

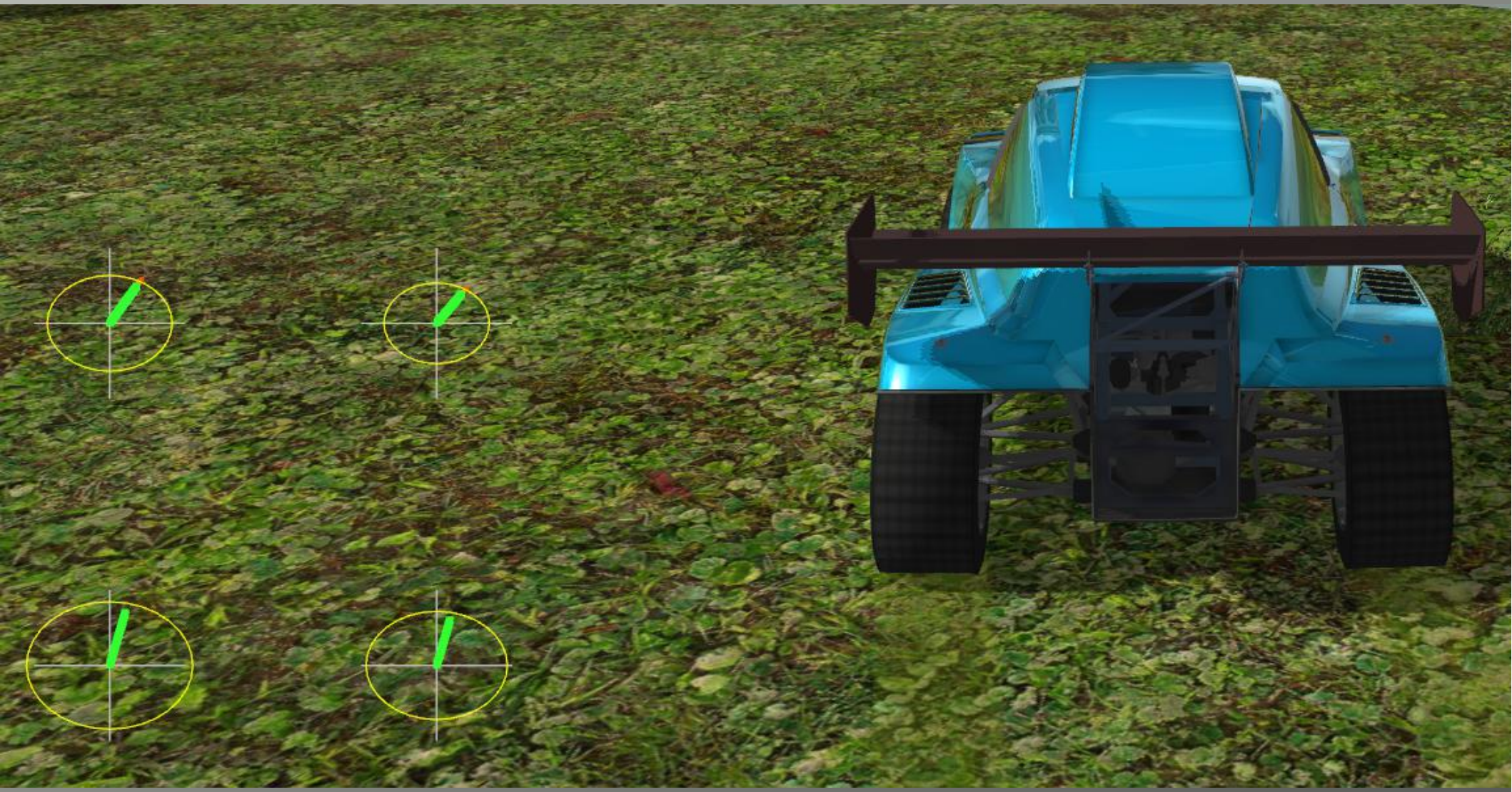
Cyan: Fy(α) lateral force (resist)
From 'slide' (α, angle, between wheel's direction and its moving, velocity v)

Stiffness (big at start) is probably the first derivative.

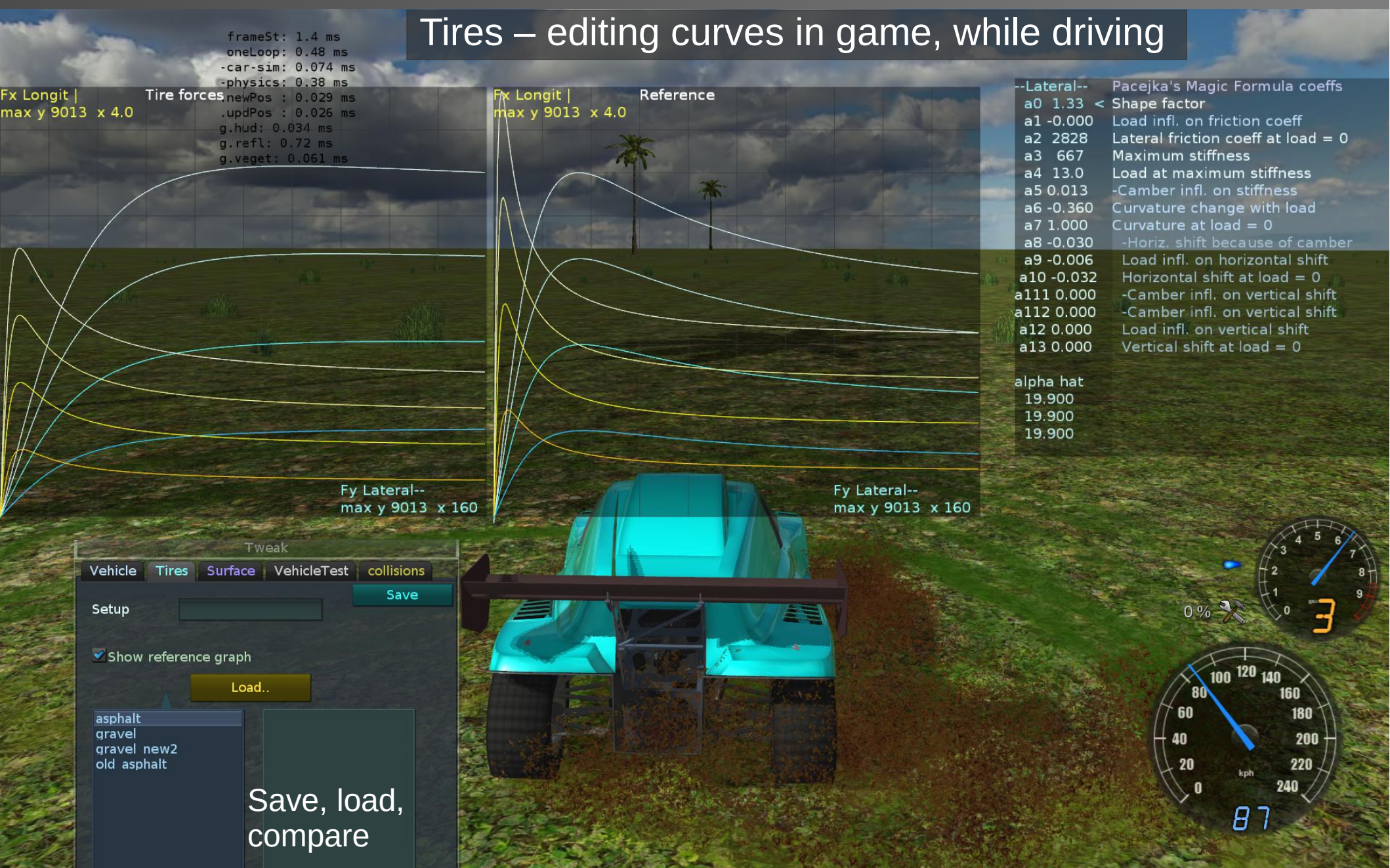


Functions change scale and shape from load (force) - here 4 curves, and camber (γ, skew angle, ignored in game).

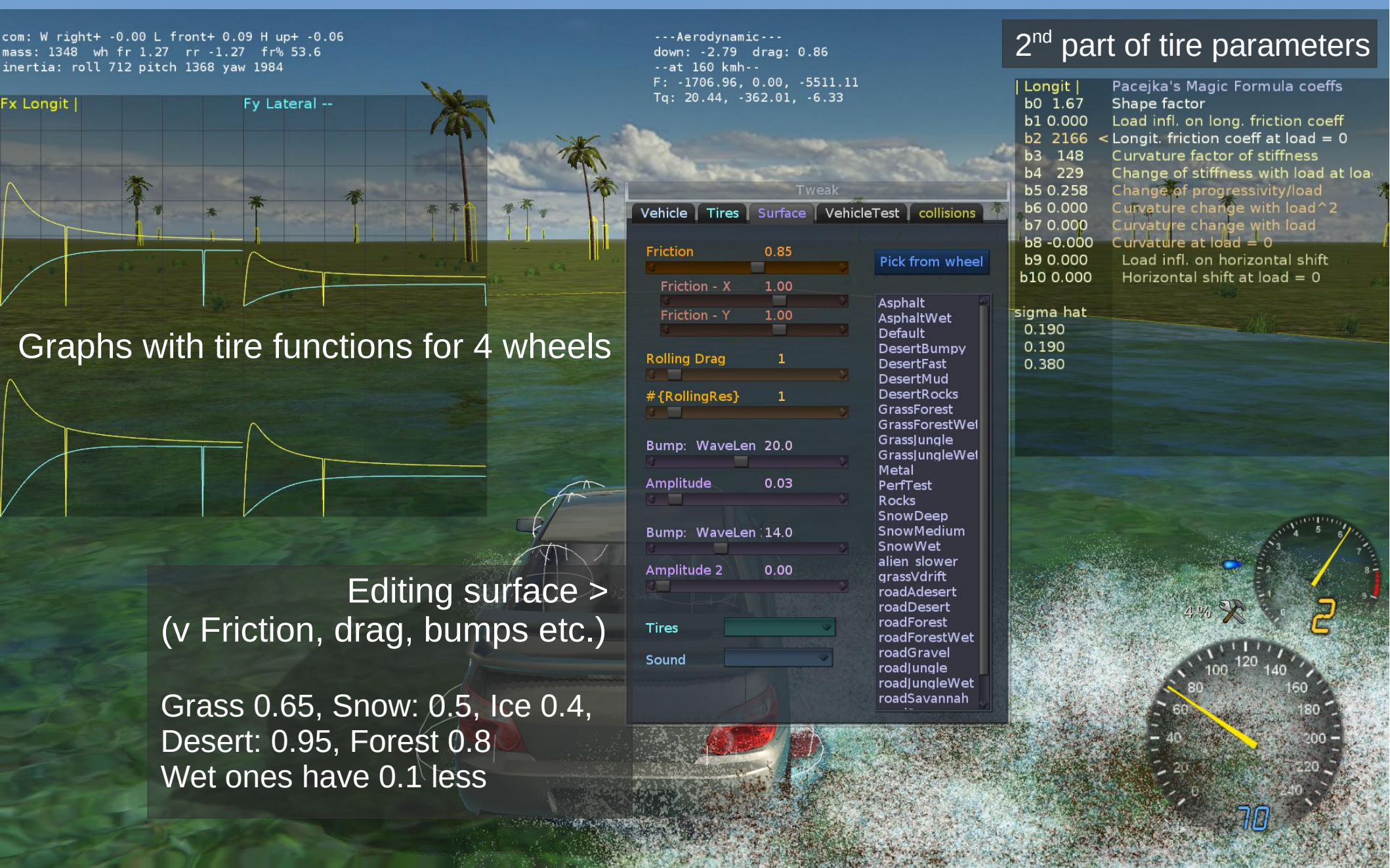
Friction circles - max tire force, *combined* both Fx and Fy



Tires – editing curves in game, while driving



2nd part of tire parameters



Graphs with tire functions for 4 wheels

Editing surface >
(v Friction, drag, bumps etc.)

Grass 0.65, Snow: 0.5, Ice 0.4,
Desert: 0.95, Forest 0.8
Wet ones have 0.1 less

Tire functions view, for 4 wheels

About 20 parameters
for tire, many zeros
Maybe 10 important.

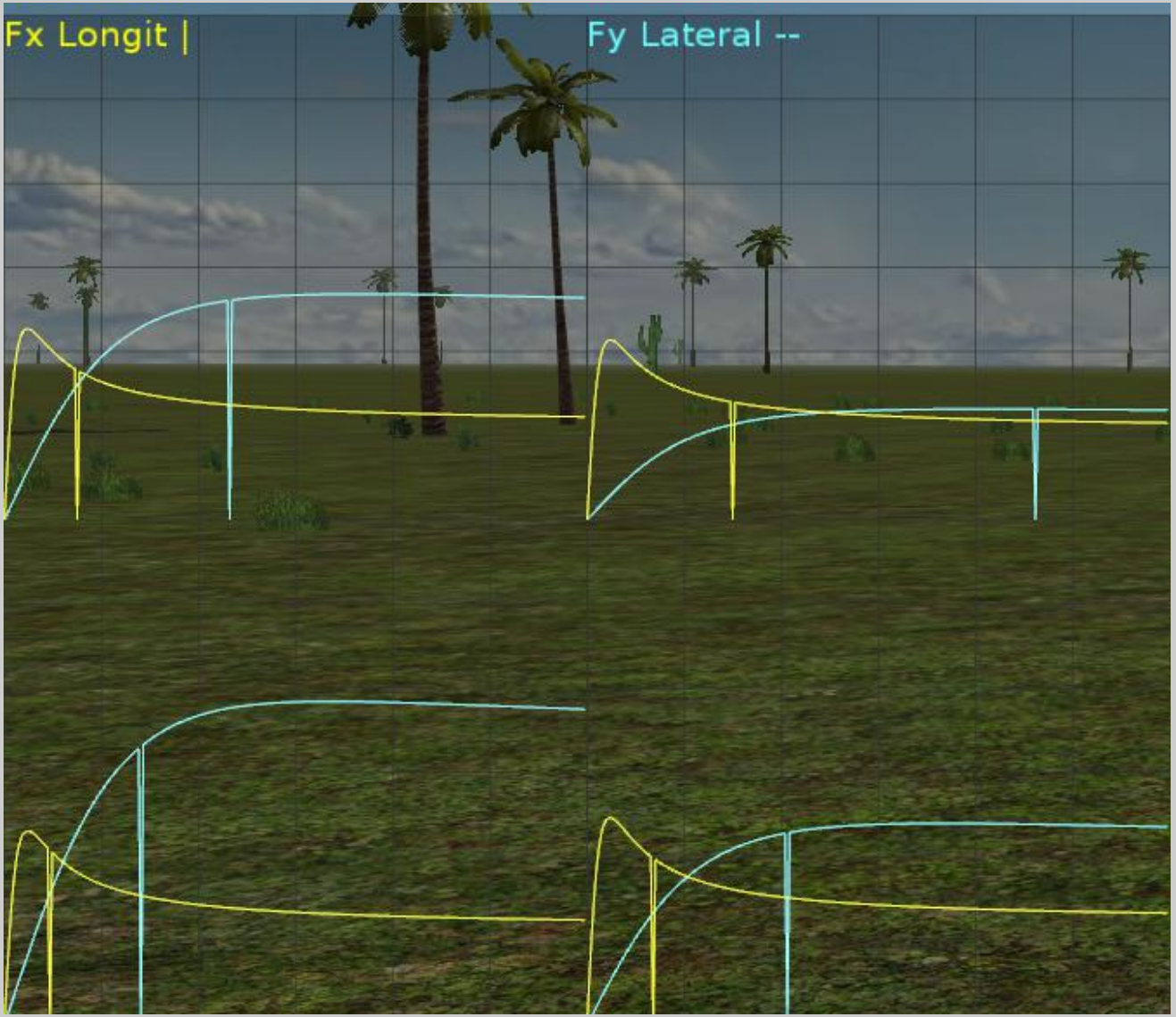
Editing for gameplay,
not realism.

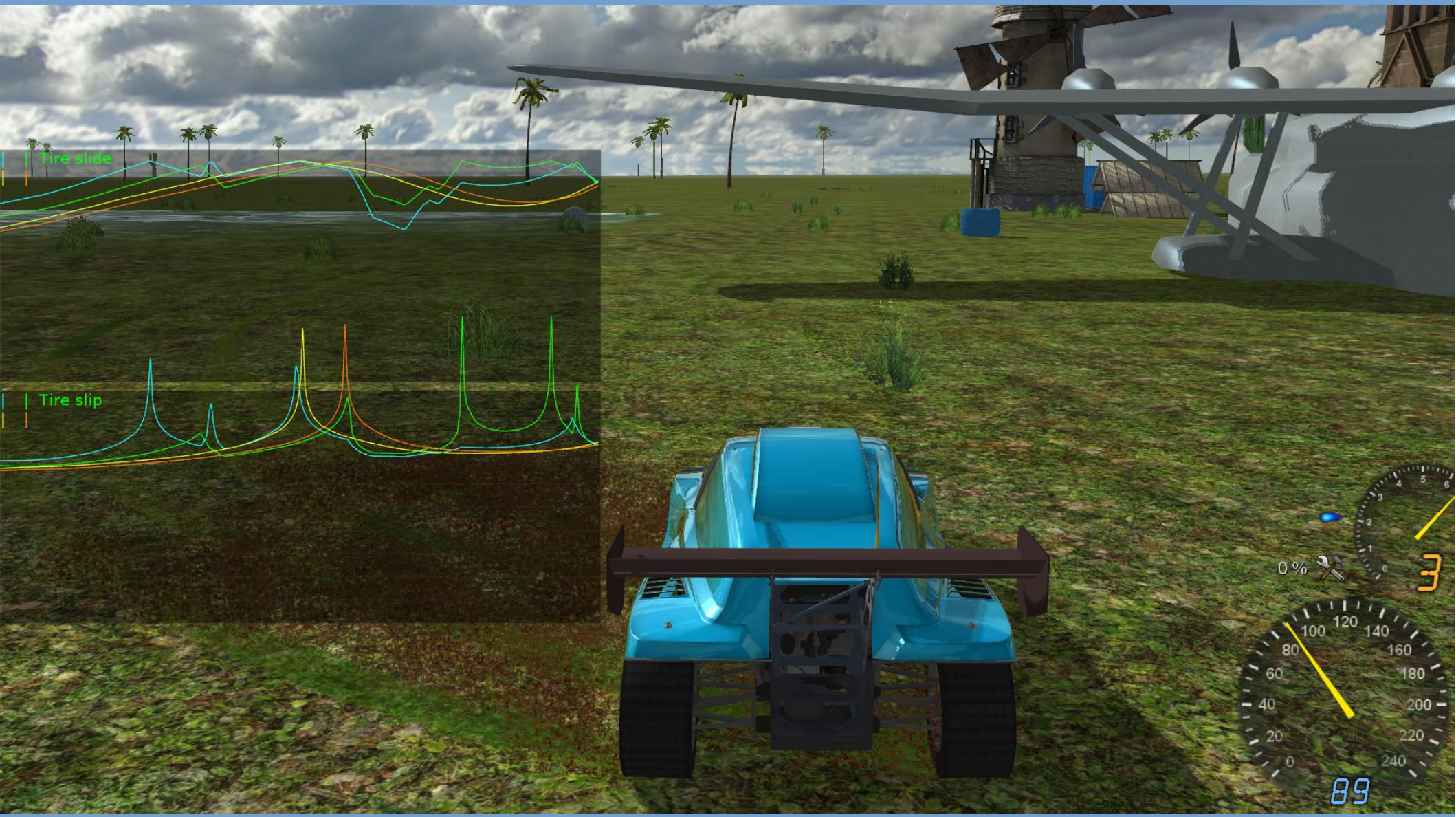
Real data unavailable.
Many tire models.

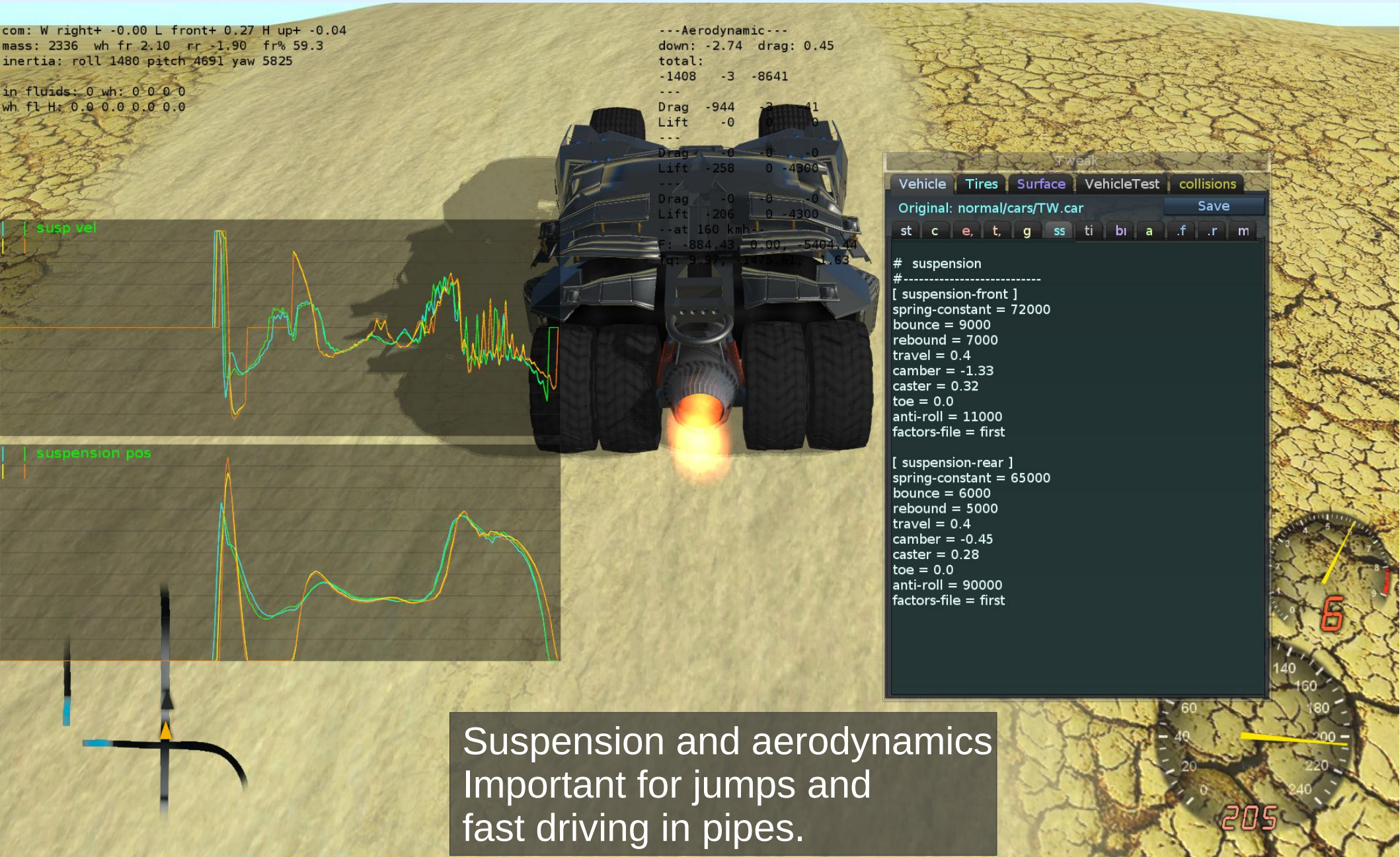
Pacejka's Magic Formula
model - popular, old.

VDrift
Has even 10 parameters
more for combining.

There are books
about tires..




Tire slide
Tire slip
0 %
3
89



Suspension and aerodynamics
Important for jumps and
fast driving in pipes.

Particles and trails
(from OGRE)

aka adventures with cassette tape

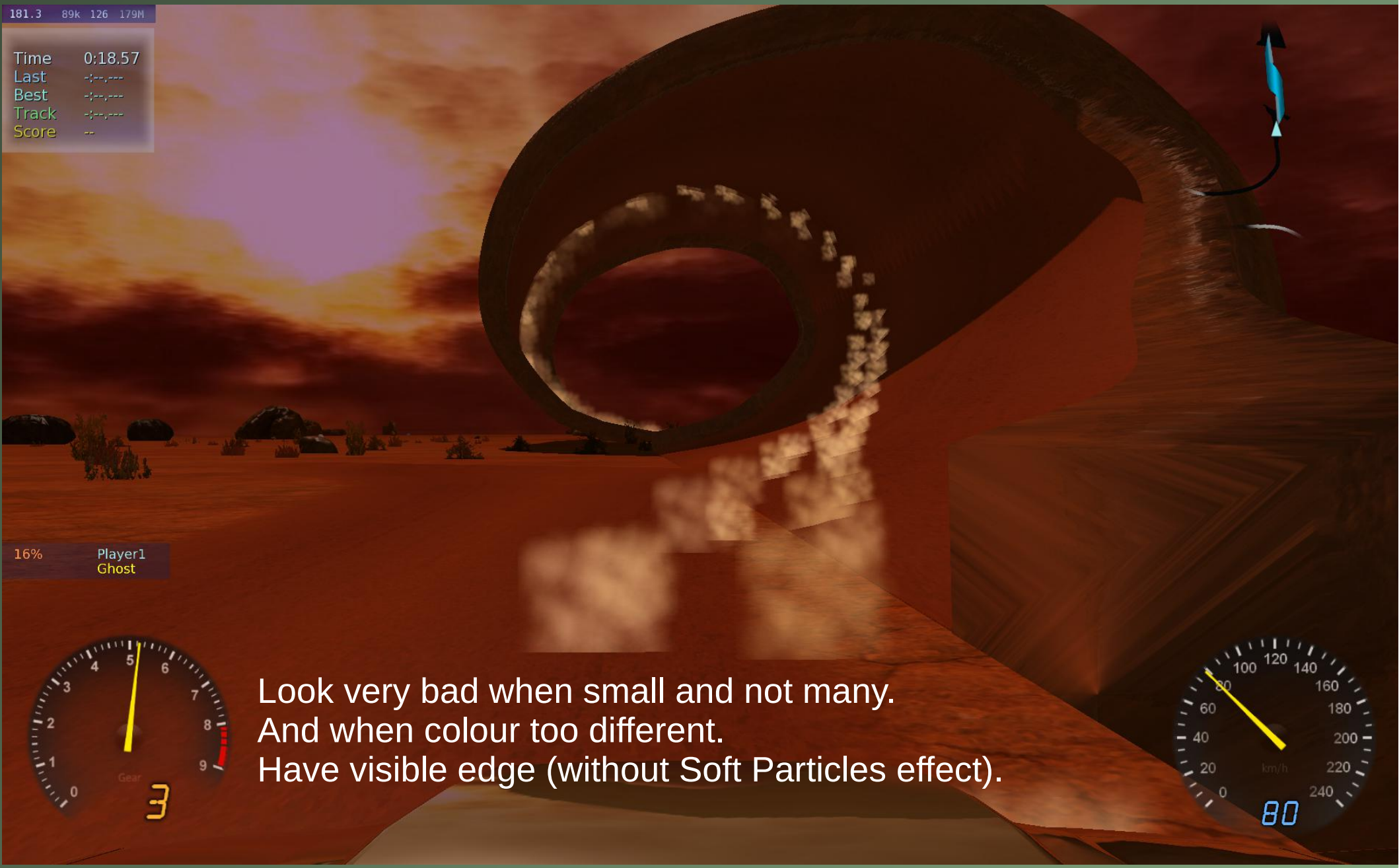
Change only colour, texture 1D

Tire trails

For each wheel:
Dust, gravel, water, mud

Each system is 1 batch
- therefore not many variations
OGRE, too few parameters for
e.g. colour, size

Sparks..


181.3 89k 126 179M
Time 0:18.57
Last -:--.---
Best -:--.---
Track -:--.---
Score --
16%
Player1
Ghost
Gear
3
km/h
80
Look very bad when small and not many.
And when colour too different.
Have visible edge (without Soft Particles effect).

Boost,
Brake lights
Weather: rain,
snow, storm

<Back
Sun
Terrain
Layers
Grasses
Vegetation
Surface
Road
Objects
Layer 1 grass ground
Layer 2 ground mud
Layer 3 jungle mntn
Layer 4
Road 1 roadJungle
Road 2 roadMud
Road 3
Road 4
Pipe 1 pipeAsphalt
Pipe 2 pipeGlass
Pipe 3 pipeGlassCyan
Pipe 4
Setting drivable surfaces feel in editor.
< For Terrain layers
< Road materials (can be 1 for all)
< and Pipes
Particles and Trails,
v
Type (friction, bumps, drag, sound)
Only 1 road surface
Particle amounts
dust 0.00 Dust
dust size 0.20
mud 0.80 Mud
smoke 0.00 Smoke
trail color
\ combos common on track
- sliders for each surface
Surface
GrassForest
Friction 0.65
Rolling Drag 60.0
Bump: WaveLen 20.0
Amplitude 0.15
Tires gravel
Sound Grass

Other components

(shortly)

Sound, Replay, GUI, Effects

Sound

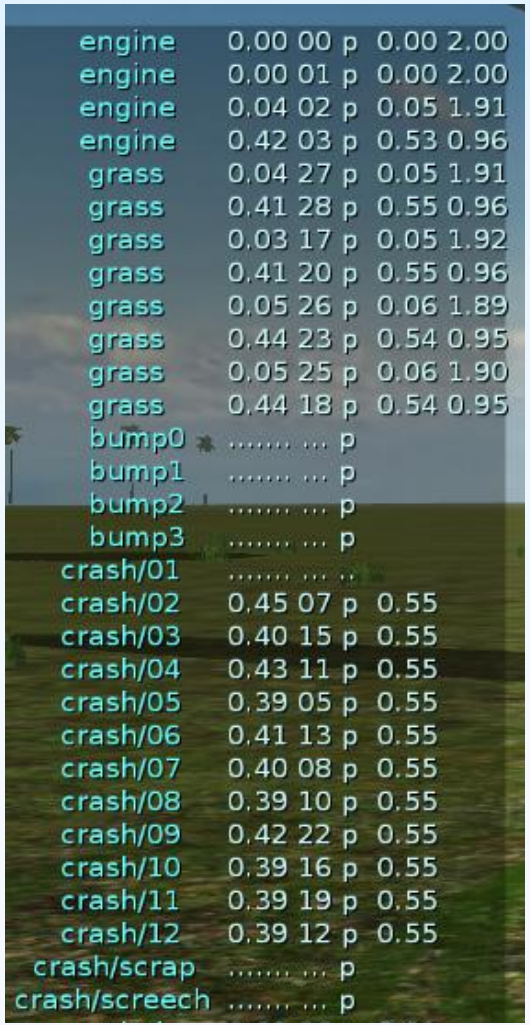
Code with VDrift. All on CPU, trouble with 3D since other axes.
Added simple code for hit sounds and metal scraping and screech.
Data for hit contact: force, velocity, etc. from bullet.

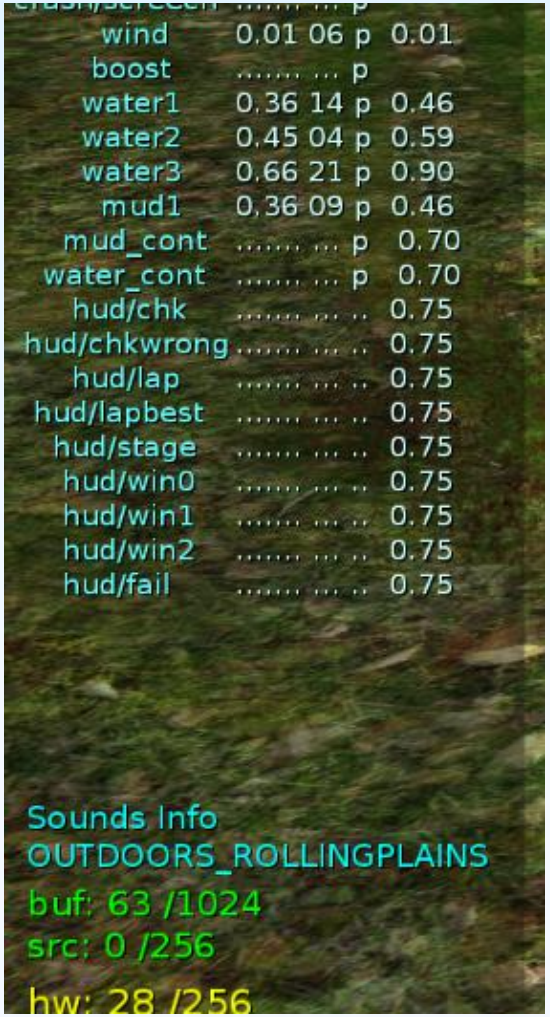
No free sounds of car engines:
continuous for 4sec, at constant rpm (thus mainly 1 for all cars).
Sounds CC0, CC-BY etc. from: https://www.freesound.org/browse/

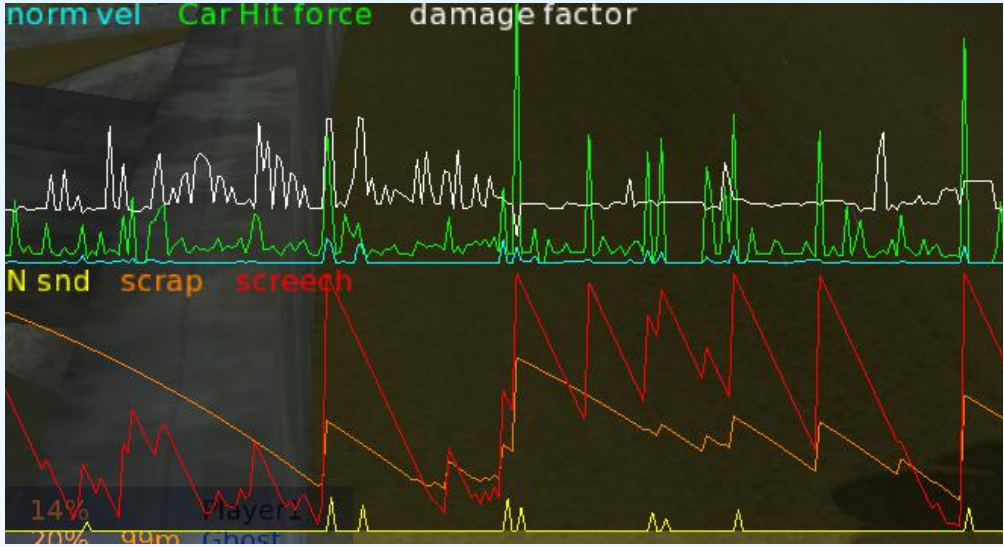
OpenAL Soft (in 2.6) allowed using Reverb.
Already there with many presets e.g. Cave, Forest, Hall etc.
Better 3D.
Code mine, based on RigsOfRods implementation,
Dynamic creating new sounds and deleting silent (ended) ones.

But can't have an oscilloscope visualization (was before).

Sound


engine 0.00 00 p 0.00 2.00
engine 0.00 01 p 0.00 2.00
engine 0.04 02 p 0.05 1.91
engine 0.42 03 p 0.53 0.96
grass 0.04 27 p 0.05 1.91
grass 0.41 28 p 0.55 0.96
grass 0.03 17 p 0.05 1.92
grass 0.41 20 p 0.55 0.96
grass 0.05 26 p 0.06 1.89
grass 0.44 23 p 0.54 0.95
grass 0.05 25 p 0.06 1.90
grass 0.44 18 p 0.54 0.95
bump0 .... p
bump1 .... p
bump2 .... p
bump3 .... p
crash/01 ....
crash/02 0.45 07 p 0.55
crash/03 0.40 15 p 0.55
crash/04 0.43 11 p 0.55
crash/05 0.39 05 p 0.55
crash/06 0.41 13 p 0.55
crash/07 0.40 08 p 0.55
crash/08 0.39 10 p 0.55
crash/09 0.42 22 p 0.55
crash/10 0.39 16 p 0.55
crash/11 0.39 19 p 0.55
crash/12 0.39 12 p 0.55
crash/scrap .... p
crash/screech .... p


wind 0.01 06 p 0.01
boost .... p
water1 0.36 14 p 0.46
water2 0.45 04 p 0.59
water3 0.66 21 p 0.90
mud1 0.36 09 p 0.46
mud_cont .... p 0.70
water_cont .... p 0.70
hud/chk 0.75
hud/chkwrong 0.75
hud/lap 0.75
hud/lapbest 0.75
hud/stage 0.75
hud/win0 .... 0.75
hud/win1 .... 0.75
hud/win2 .... 0.75
hud/fail 0.75
Sounds Info
OUTDOORS_ROLLINGPLAINS
buf: 63 /1024
src: 0 /256
hw: 28 /256


norm vel
Car Hit force
damage factor
N snd
scrap
screech
14%
Player1

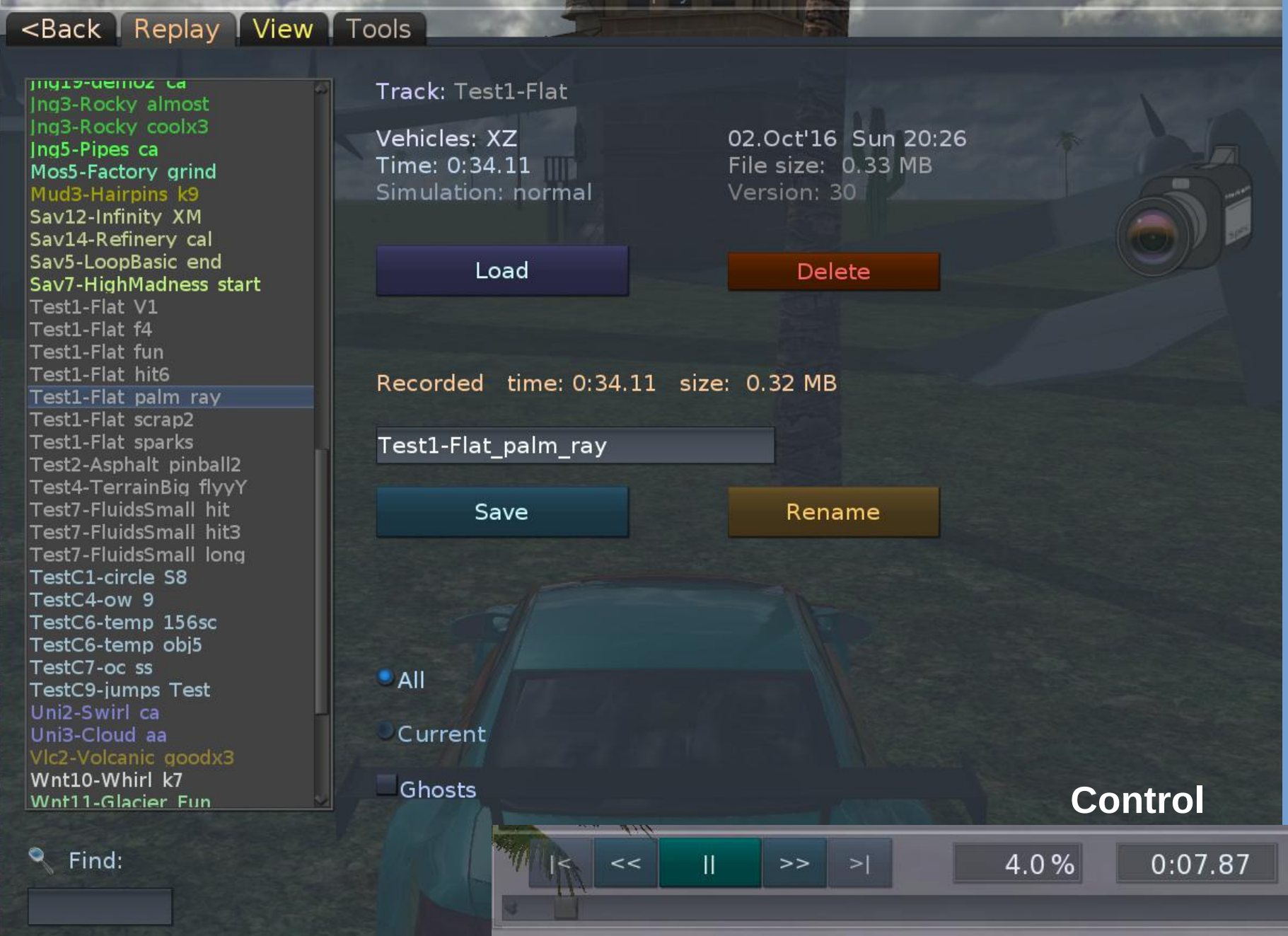
Replay, Ghost

Replay – for long old: 4 MB for 1 minute, few GB whole!
Was saving all floats, every frame, 160 Fps:
wheel positions (3), rotations (4), particle emit values, submerges, etc.

Allowed easily creating **Ghost**, your best (or previous) drive.
Later also Rewind.
Can forward, backward, pause, change camera etc.

Lately rewritten using half.hpp (16bit) and sparingly
80 Fps, supporting any number of **players and wheels**.
For vehicles with 6 i 8 wheels which I didn't finish.
Now 1MB per minute.
Can anyway be compressed to about 62%.

Track's ghost very small since beginning,
40 Fps (with interpolation), no wheels.


<Back
Replay
View
Tools
Jng3-Rocky almost
Jng3-Rocky coolx3
Jng5-Pipes ca
Mos5-Factory grind
Mud3-Hairpins k9
Sav12-Infinity XM
Sav14-Refinery cal
Sav5-LoopBasic end
Sav7-HighMadness start
Test1-Flat V1
Test1-Flat f4
Test1-Flat fun
Test1-Flat hit6
Test1-Flat palm ray
Test1-Flat scrap2
Test1-Flat sparks
Test2-Asphalt pinball2
Test4-TerrainBig flyyY
Test7-FluidsSmall hit
Test7-FluidsSmall hit3
Test7-FluidsSmall long
TestC1-circle S8
TestC4-ow 9
TestC6-temp 156sc
TestC6-temp obj5
TestC7-oc ss
TestC9-jumps Test
Uni2-Swirl ca
Uni3-Cloud aa
Vlc2-Volcanic goodx3
Wnt10-Whirl k7
Wnt11-Glacier Fun
Find:
Track: Test1-Flat
Vehicles: XZ
Time: 0:34.11
Simulation: normal
02.Oct'16 Sun 20:26
File size: 0.33 MB
Version: 30
Load
Delete
Recorded time: 0:34.11 size: 0.32 MB
Test1-Flat_palm_ray
Save
Rename
All
Current
Ghosts
Control
|<
<<
||
>>
>|
4.0 %
0:07.87
3:17.23

GUI

MyGUI has most of controls. Scaling needs to be done in code.
My code for pair Slider+Value(+Edit): update float* (or int*). Checkbox too. Separated common class, for options both in game and editor.

Code in Gui_Init.cpp, assigning events for all Gui controls is one of the longest and repeated codes.
Many short #define-s to make it shorted and clearer.

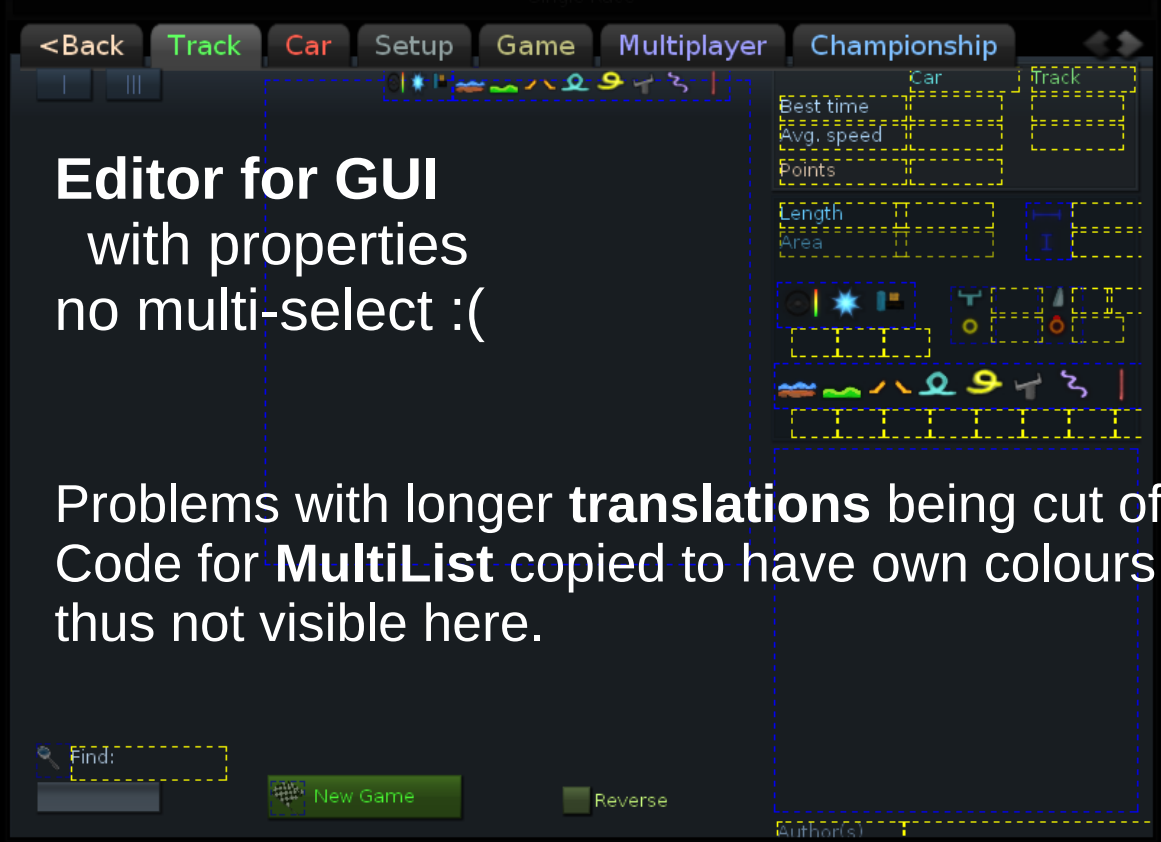
This is one line (there are as many as sliders on Gui):

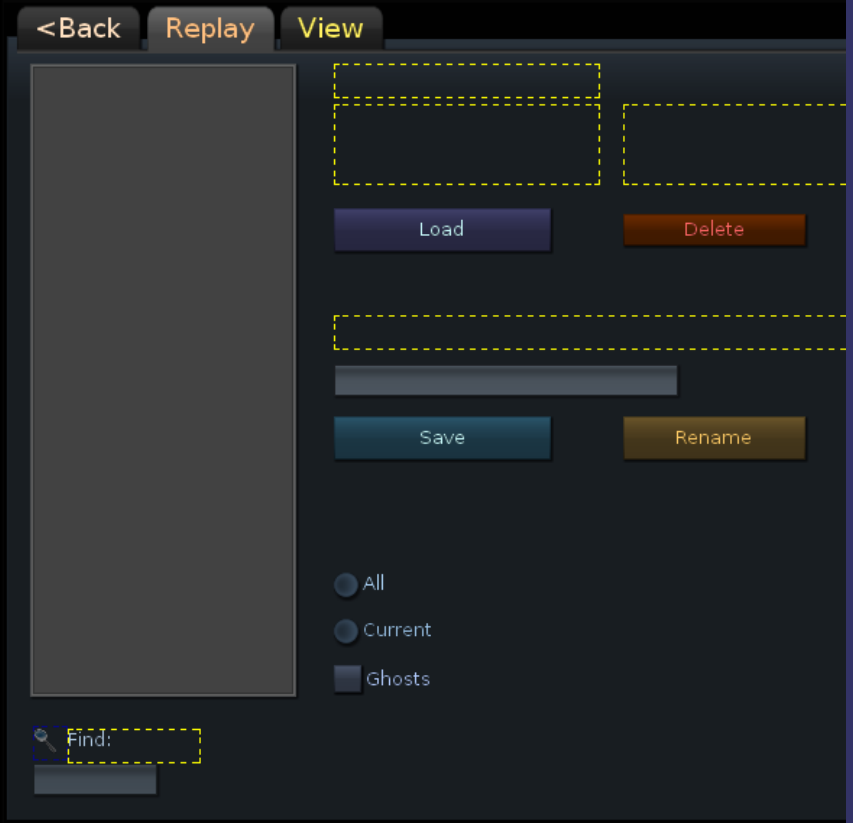
```
sv= &svSizeMinimap;
sv->Init("SizeMinimap",     &pSet->size_minimap,   0.05f, 0.3f, 1.f, 3,4);
sv->DefaultF(0.165f);  Sev(HudSize);

ck= &ckTrails; ck->Init("TrailsOn", &pSet->trails); Cev(ParTrl);
```

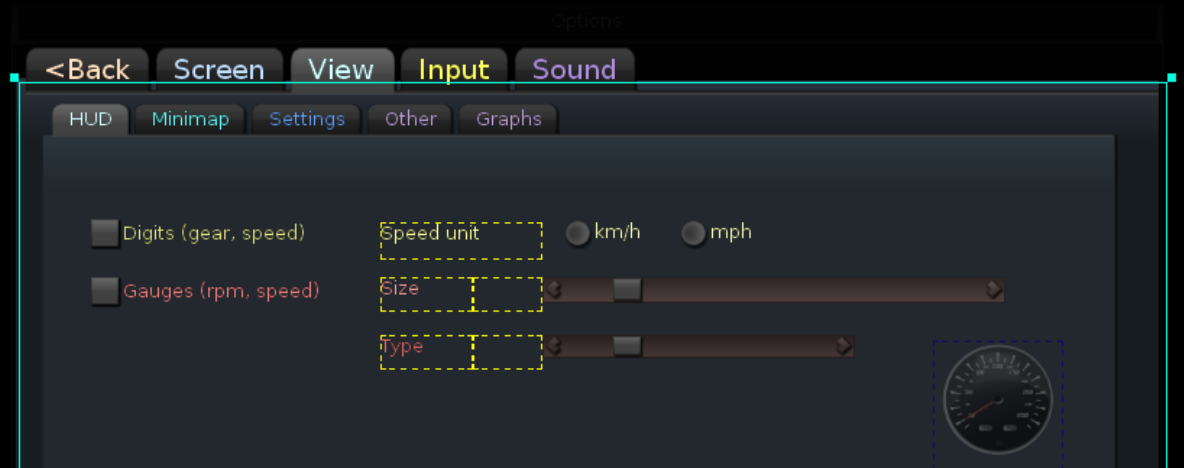
GUI can be seen next..
There are plenty of GUI libraries to choose.

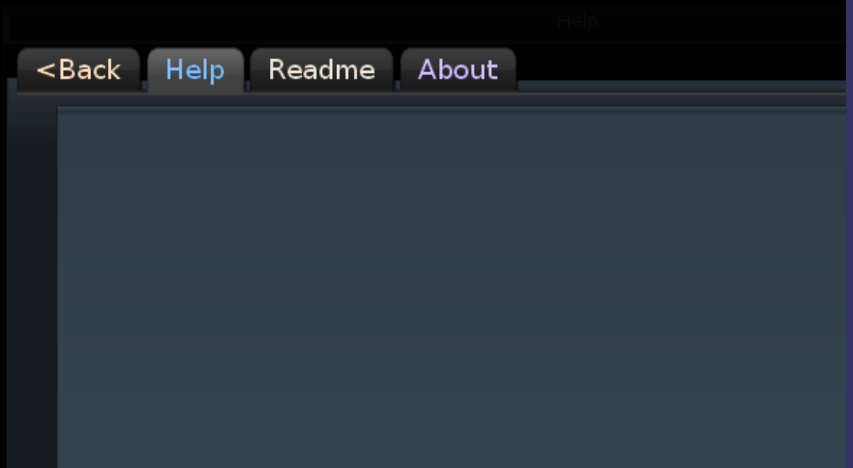
Editor for GUI
with properties
no multi-select :(

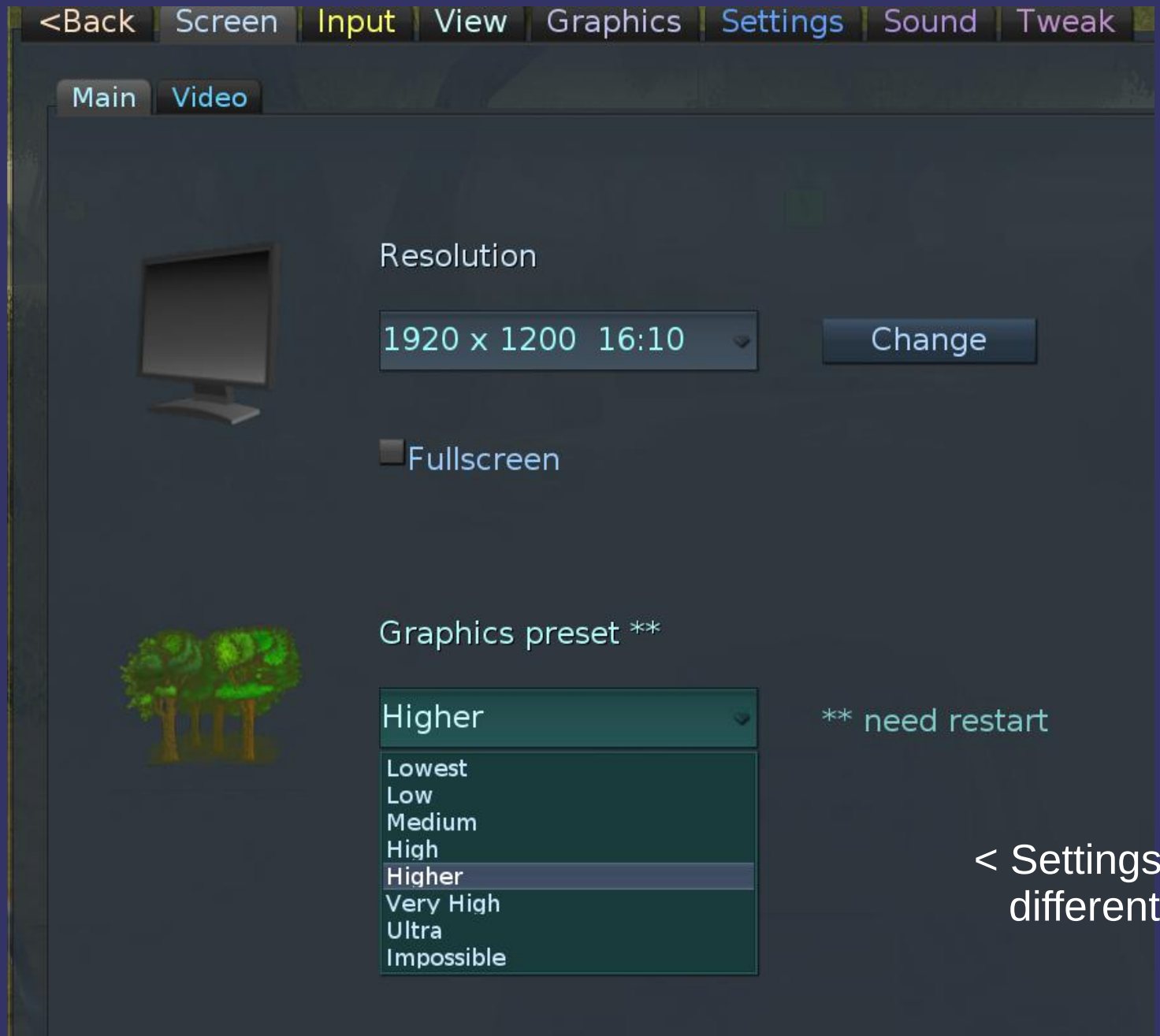
Problems with longer **translations** being cut of.
Code for **MultiList** copied to have own colours, thus not visible here.



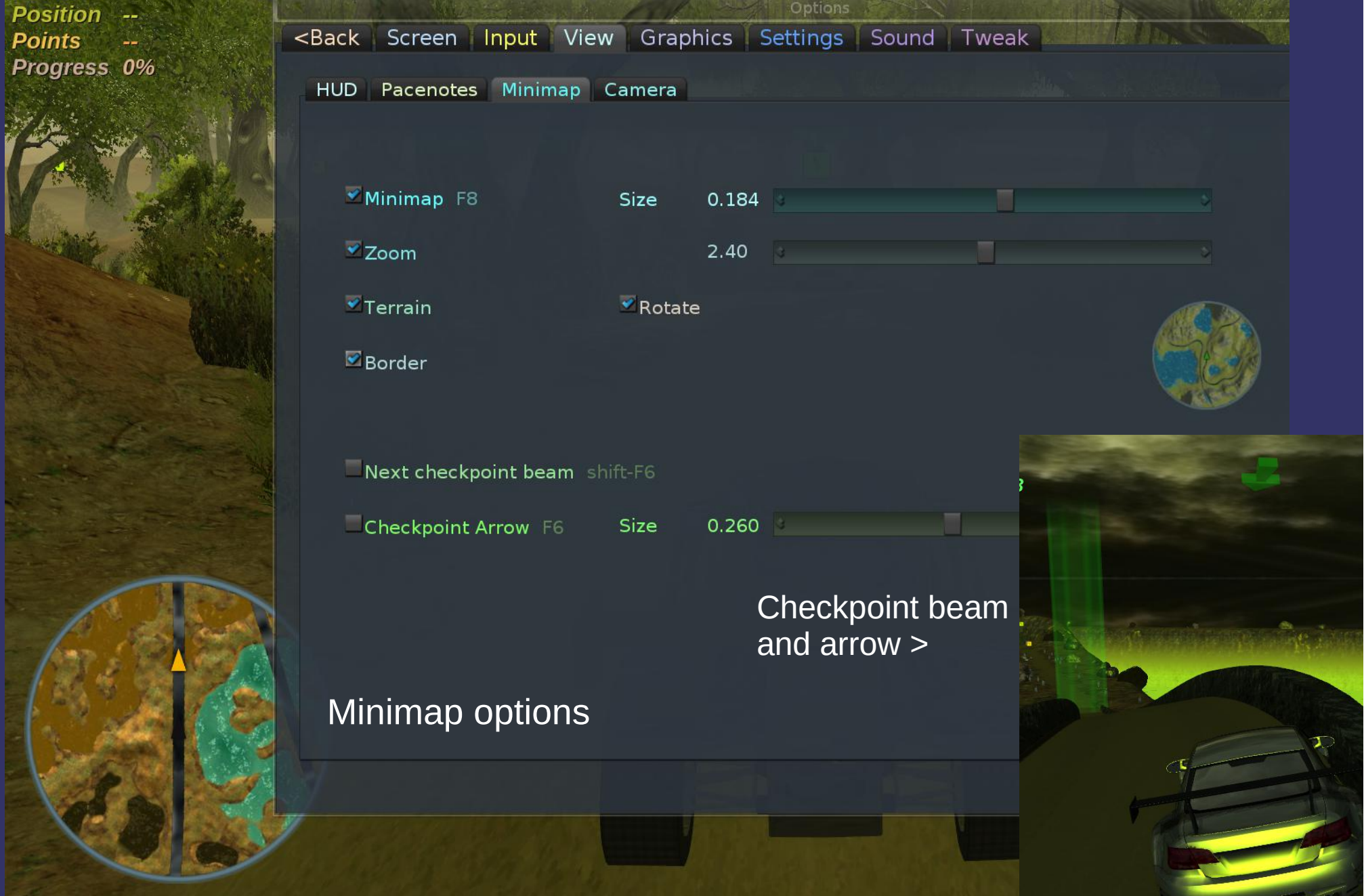


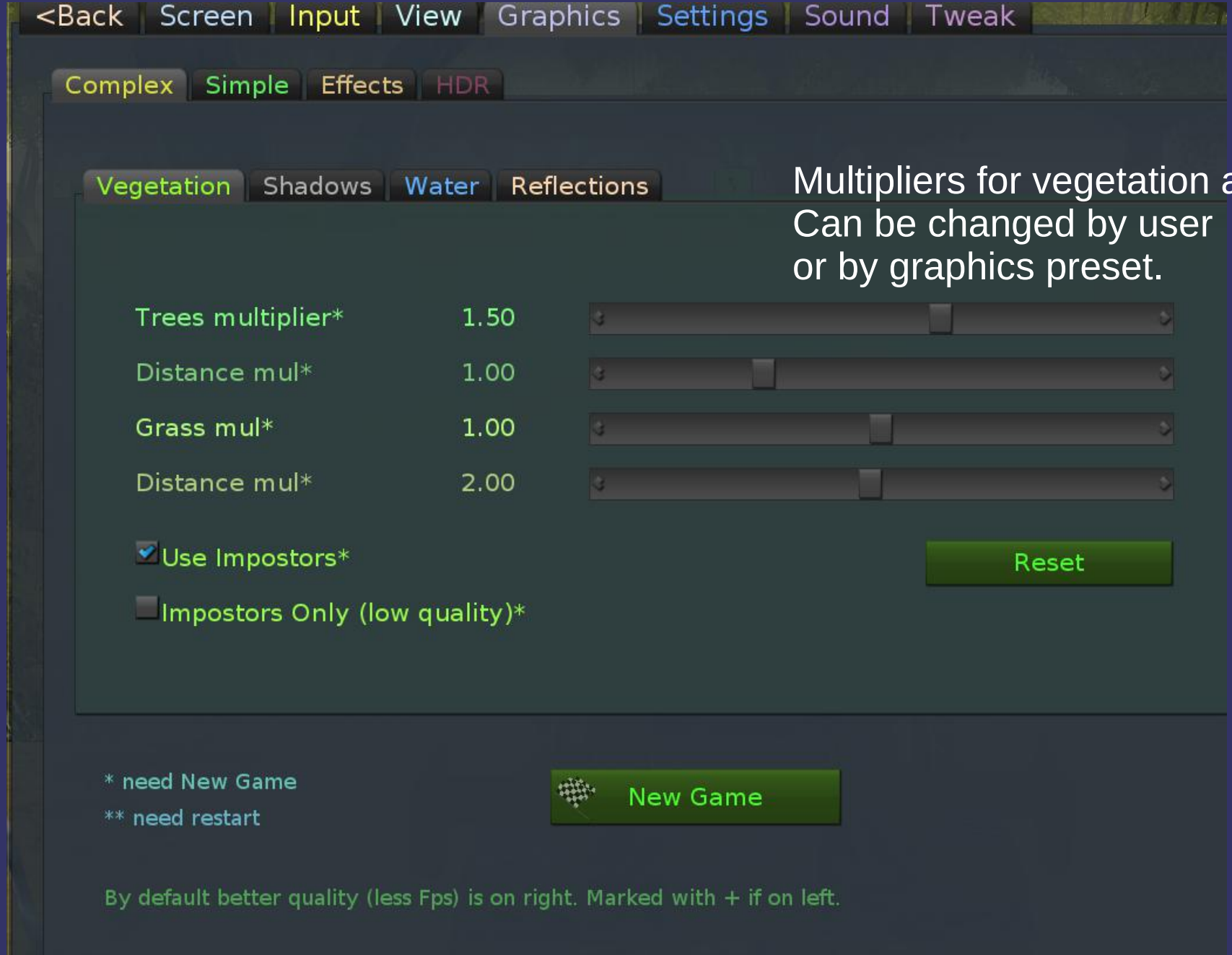






< Settings to adjust for different GPUs


Position --
Points --
Progress 0%
Options
<Back
Screen
Input
View
Graphics
Settings
Sound
Tweak
HUD
Pacenotes
Minimap
Camera
Minimap F8
Size 0.184
Zoom 2.40
Terrain
Rotate
Border
Next checkpoint beam shift-F6
Checkpoint Arrow F6
Size 0.260
Checkpoint beam and arrow >
Minimap options



Multipliers for vegetation and grass
Can be changed by user
or by graphics preset.

Effects

Very poor performance in old OGRE, Fps drop to 70%
Developed by *scrawl* and *ahmed.* Present are:

Bloom – added brighter, post process, (is OK for Fps)
Motion blur – old leaving frames and lately newer version
Soft Particles – smooth dust, no edges etc. (too demanding)
SSAO – good, but demanding, Screen Space Ambient Occlusion

DOF – depth of field (blurs further, not real)
God Rays – rays from sun, cool but not working. Sun Flare not present.
HDR – High Dynamic Range

Old algorithm, too much saturation, blurs skies, garbage.
Including: film grain, vignetting (nonsense).

Bloom
Blur
SSAO
HDR
Rays

Models

Objects

Models - objects

Blender, plugin for export to OGRE, .mesh (and .mesh.xml) files.

Lots of models on blendswap
Licenses: CC0, CC-BY-SA (we want no NC, ND, more freedom):
http://www.blendswap.com/terms/category/vehicles/

Trees need special care, 1 mesh for leaves, 1 for trunk, edit xml, made a tool.
In addition used SnappyTree - cool web generator for trees with sliders.

Objects
Static: buildings (plenty from 0AD, middle aged, alien new, skyscrapers),
houses, obstacles, cave rocks, balloons, statues, etc.
Dynamic: barrels, crates, and bigger ones.
Require adding shapes (and parameters) **physics**, in Blender (has bullet).
In editor don't have scaling and need **simulation** until they settle.

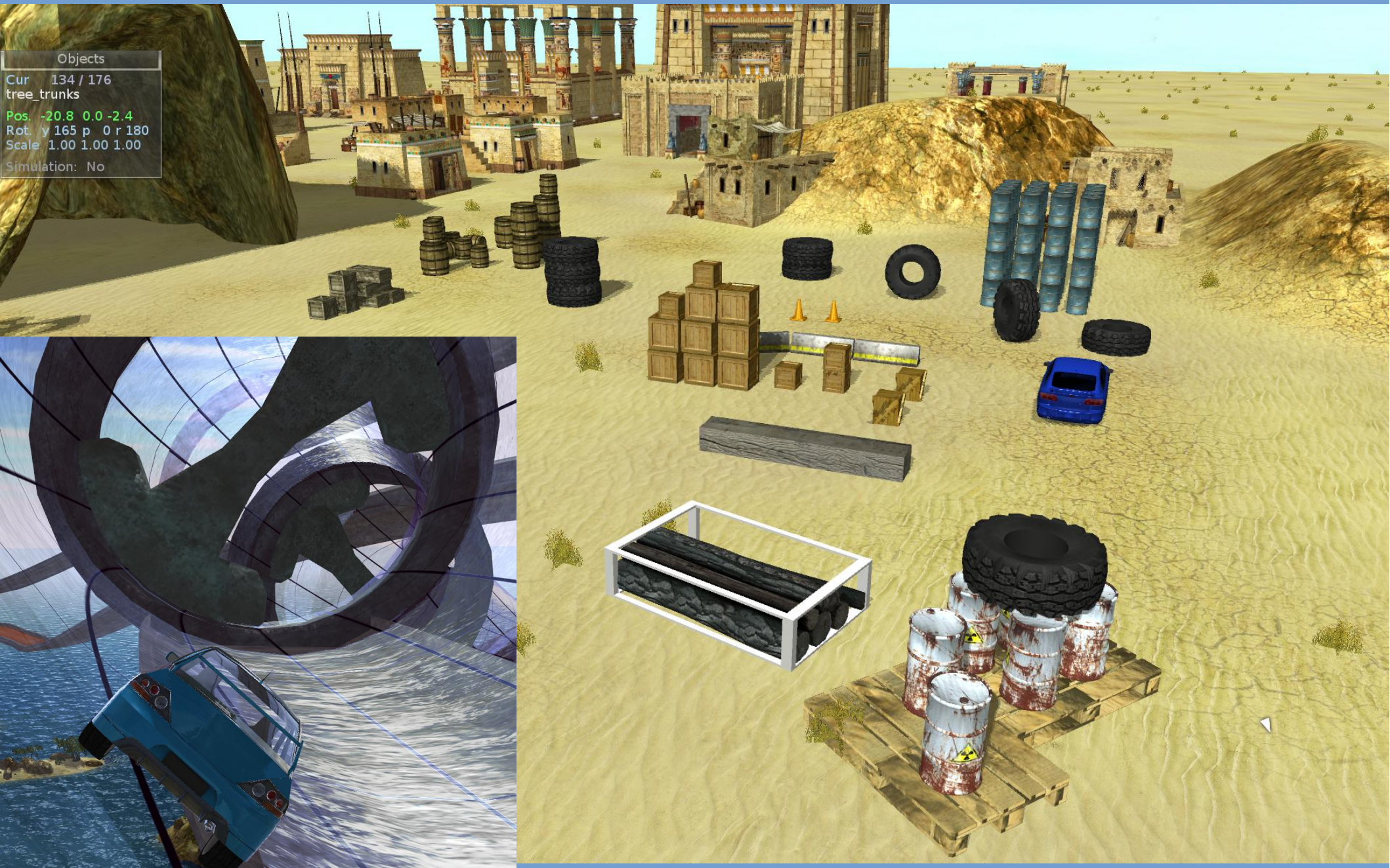
Tutorial: https://stuntrally.tuxfamily.org/wiki/doku.php?id=objects

Selecting many:

Copy, Paste,
Move, Rotate, Scale
around picked one [box]

Simulation:
here they fall and align
straight on ground.

Game creates in
sleep at start
(to not simulate).

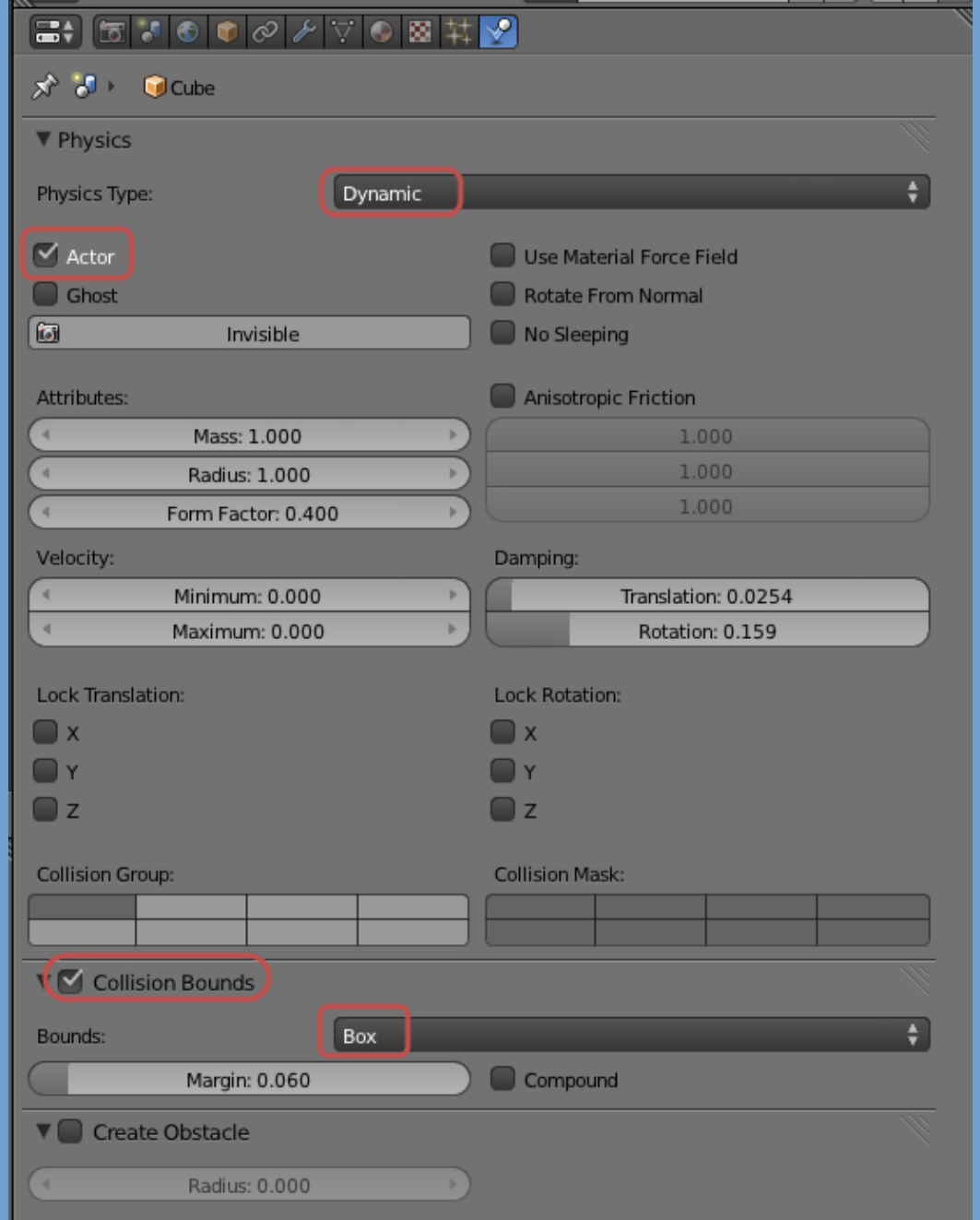

Objects
Cur 134 / 176
tree_trunks
Pos. -20.8 0.0 -2.4
Rot. y 165 p 0 r 180
Scale 1.00 1.00 1.00
Simulation: No

Parameters set
in Blender: on next..
And collision shapes:
box, cylinder, .. etc.

In Blender:

Mass, inertia,
Friction
Damping move, rotation
max velocity,
collision margin

Exports .bullet files



148.9 109k 42 152M
Time 0:04.16
Last -:--.--
Best 0:39.83
Track 0:41.91
Position 1
Points 10/8
Ambient occlusion

Buildings from 0 A.D. game (strategy)

Objects lists

Models

Vehicles

Models – Vehicles 1

Vehicles require a lot of tedious work (about 2-3 weeks for 1):

- **Decreasing** triangle count to about 60-200k,
  less iterations, decimate. There are no LODs :(but less work.

- **Join, Split** of meshes to use only 3, for:
  - Body, coloured (metal which is given colour by game)
  - Interior (and exterior)
    not coloured (panels, seats, steering wheel, dashboard, lamps, etc.)
  - Glass (windows), can also be used for lamp fronts
  - Wheel(s) separated, brakes own mesh
    best 1 mesh (can have rubber and metal at once in 1 material)

- **UV unwrap**, splitting to 2D, of each 3D sub-object, placing in different location on texture

Models – Vehicles 2

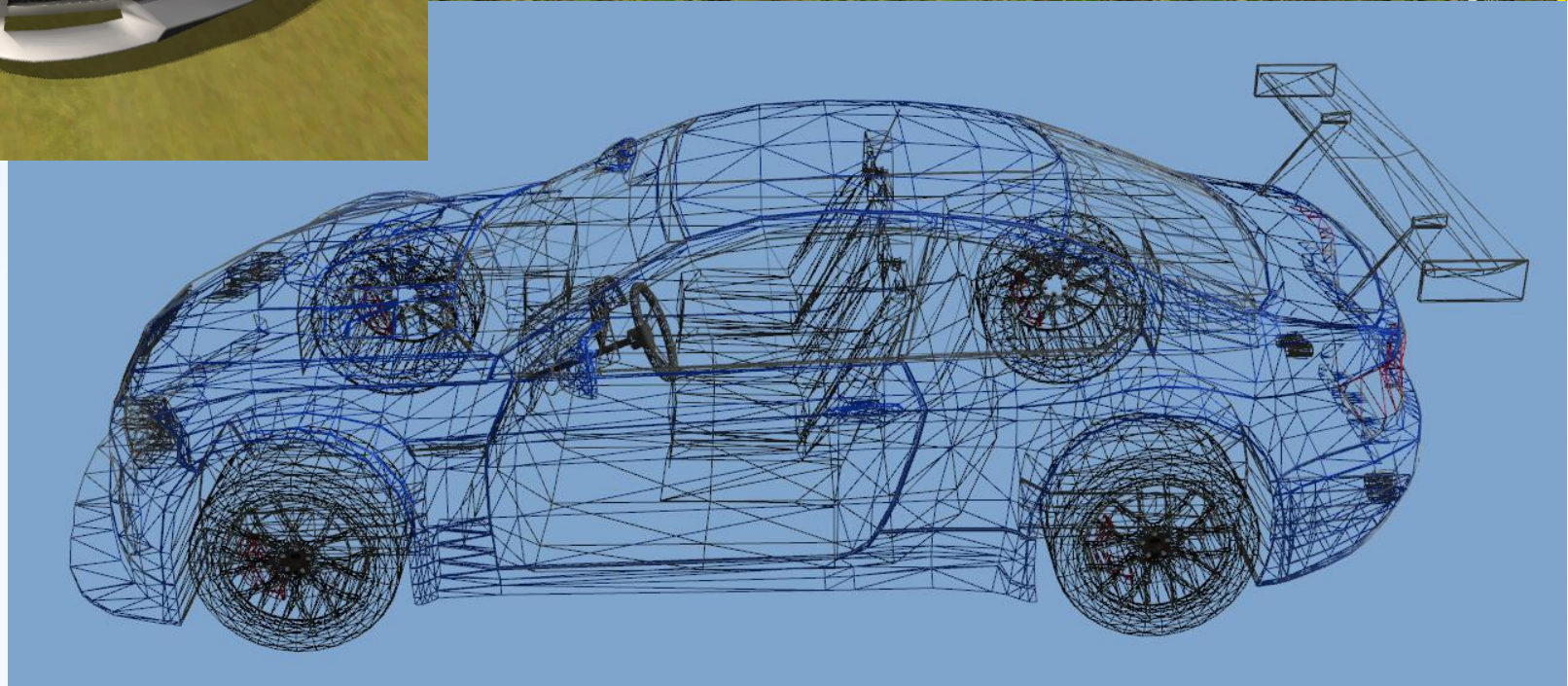
Baking Ambient Occlusion (not necessary but preferred)
in Blender. Creates shadows “from itself”, look better in game.

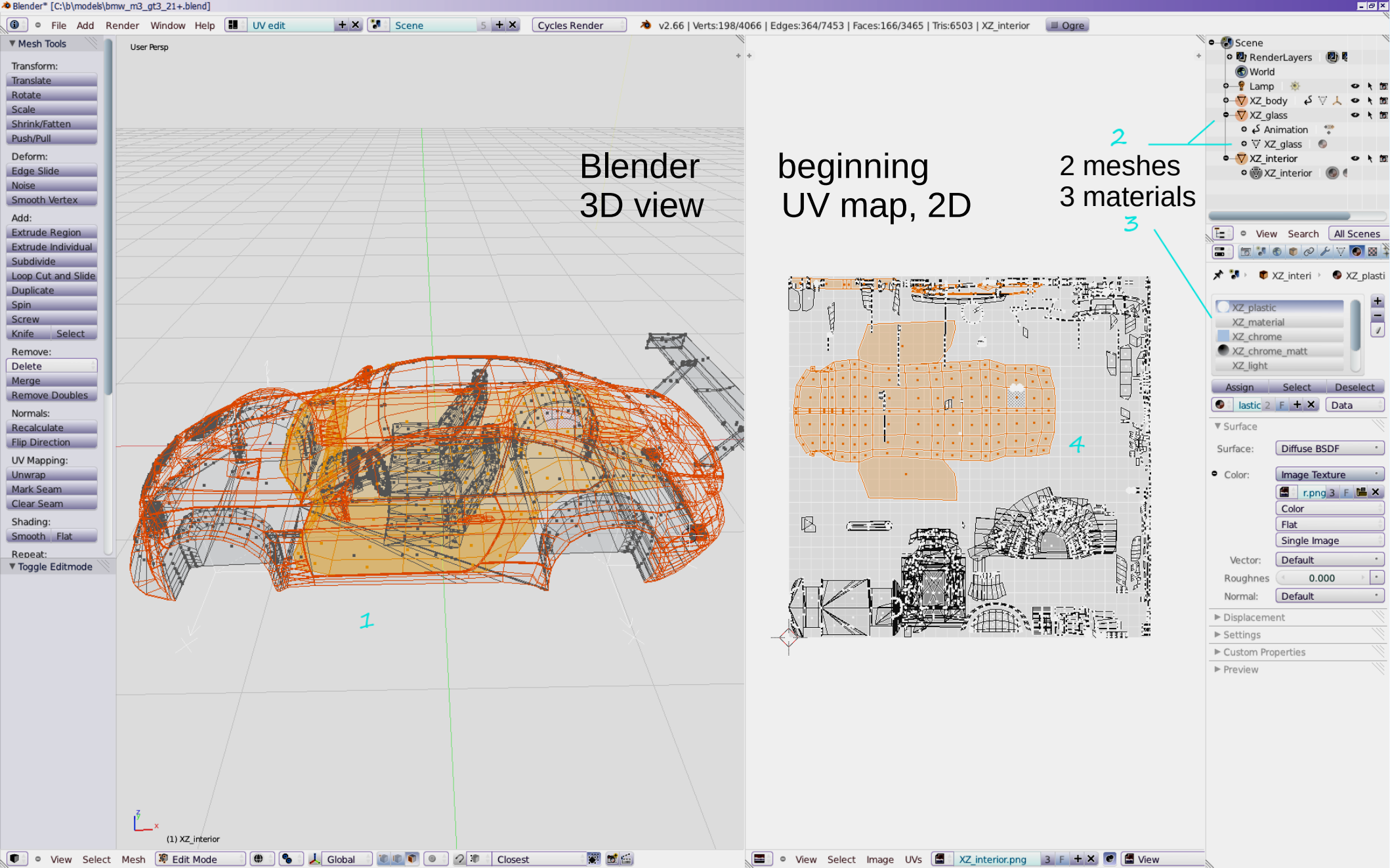
Editing textures (and materials). Can have many:
diffuse, specular (where shines),
reflect (where metal, mirror).
Done in: **GIMP**, Paint.NET, Inkscape.

- Editing and fitting **simulation** (**.car** setup)
  - **Collision** spheres, to cover whole vehicle shape, Placement of **wheels**
  - Testing **centre of mass**, sliding, no rolling over
  - **Aerodynamics**, downforce, but also:
  - Good flight in **jumps**, suspension length
  - **Engine** (torque curve) and power, acceleration
  - Braking, handbrake, **Performance tests** (results)
  - All cars have 4WD and **3 differentials**, possible corrections

Car: 43k triangles
1 wheel: 12k

Total: 92k
2MB,
21 files



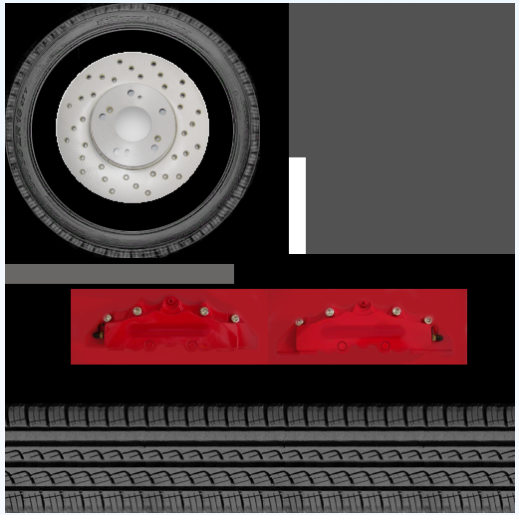

Blender 3D view
beginning UV map, 2D
2 meshes
3 materials
1
2
3
4
Blender* [C:\b\models\bmw_m3_gt3_21+.blend]
File Add Render Window Help
UV edit
Scene
Cycles Render
v2.66 | Verts:198/4066 | Edges:364/7453 | Faces:166/3465 | Tris:6503 | XZ_interior
Ogre
Mesh Tools
Transform:
Translate
Rotate
Scale
Shrink/Fatten
Push/Pull
Deform:
Edge Slide
Noise
Smooth Vertex
Add:
Extrude Region
Extrude Individual
Subdivide
Loop Cut and Slide
Duplicate
Spin
Screw
Knife Select
Remove:
Delete
Merge
Remove Doubles
Normals:
Recalculate
Flip Direction
UV Mapping:
Unwrap
Mark Seam
Clear Seam
Shading:
Smooth Flat
Toggle Editmode
User Persp
(1) XZ_interior
View Select Mesh Edit Mode Global Closest
View Select Image UVs XZ_interior.png View
Scene
RenderLayers
World
Lamp
XZ_body
XZ_glass
Animation
XZ_glass
XZ_interior
XZ_interior
View Search All Scenes
XZ_interi XZ_plasti
XZ_plastic
XZ_material
XZ_chrome
XZ_chrome_matt
XZ_light
Assign Select Deselect
lastic 2 F
Data
Surface
Surface: Diffuse BSDF
Color: Image Texture
r.png 3 F
Color
Flat
Single Image
Vector: Default
Roughnes 0.000
Normal: Default
Displacement
Settings
Custom Properties
Preview

Vehicle textures

< Body
with ambient occlusion

Interior >
with exterior elements

Wheels + normal,
v



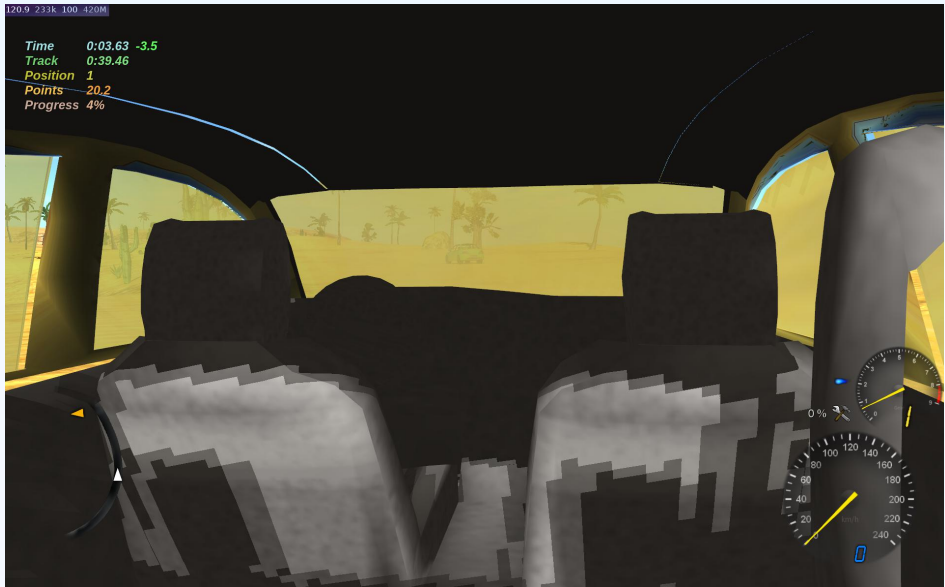
reflect, specular

Problems: Bottoms one texture, or none
Not connected wheels >

Missing parts in models from blendswap:

Disgusting interiors of cars
None at start

Missing fragments of connections from inside



Freaking shadows in thin places:
roof, spoiler

Translations

Translations

At first .po files, translated on **launchpad.net**, *very slow, unresponsive.*
Our script in Python, changing .po to .xml for MyGUI.

Today we got: 1146 strings, 668 normal, 143 tooltips - long info.

Later I made my own C++ **program**, which gathers strings from cpp and GUI layouts (xml). Reads <!-- --> with **group** names. Gets controls inheritance.

Can tell where it found, cpp/layout and line.
Also shows from GUI: general **occurrences**, where, on which (sub)tabs, **hierarchy** and which control.

Translations can be edited on web in **Transifex.com**, *convenient, filtering, etc.* Or can download **.po** and edit text, or use a tool for it like e.g. PoEdit. File tx.exe (theirs) gets new and sends.

Transifex | DASHBOARD EXPLORE HELP CryHam

sr.pot — German (de)

Overview | Concordance Search

259	Repair each lap	*Reperatur pro Runde*
260	Boost	*Boost*
261	Flip	*Umdrehen*
262	Never	*Nie*
263	Always	*Immer*
264	Any	*Alle*
265	Fuel each lap	*Jede Runde auffüllen*
266	Fuel over time	*Mit der Zeit auffüllen*
267	Boost Fuel	*Boost-Tank*
268	Number of local players	*Anzahl Spieler*
269	Split Vertically	*Senkrecht teilen*

1119 ALL | 0 UNTRANSLATED | 1119 UNREVIEWED

Translated by CryHam, 2 days ago.

Boost

Boost

Review | Save | Save all (0)

Developer note: *Game Boost*

Instructions: *Click here to add instructions for this string*

Less details

Add a tag

Key: Boost

Size: 1 word

Occurrences: Game.layout:, 1076..SingleRace.Game.Main.Text:, 1133..SingleRace.Game.Tab:, 2842..Options.View.Camera.Button:, ogre/Challenges.cpp:596, ogre/Gui_Init.cpp:521, ogre/Gui_Network.cpp:132

Context: Boost

TODO, PR

Tasks list

old Google Code

ID ▼	Type ▼	Priority ▼	Size ▼	Component ▼	Summary + Labels ▼	Progress ▼	Status ▼	Owner ▼	Modifie
77	Sticky	Above	----	----	--- ONLY for developers ---	----	Opened	----	Sep 8
265	----	Critical	Big	Graphics	Particles	----	----	----	4 days a
266	----	Critical	Big	Sound	› Sounds	05	----	CryHam	Sep 28
255	----	VeryHigh	Medium	GUI	Hud layouts, lap finish	20	----	----	Sep 28
260	----	VeryHigh	Medium	GUI	Move overlay to Gui	50	----	----	Sep 30
268	----	VeryHigh	Small	Game	Rewind types	----	----	----	Sep 28
263	----	Highest	Medium	Editor	› Checkpoints, objects	20	Stopped	CryHam	33 hours
226	----	Highest	Big	Logic	› HW instancing	20	Stopped	CryHam	Sep 8
210	----	Higher	Big	Input	Force feedback	----	Stopped	----	Sep 7
264	----	Higher	Medium	Logic	Camera extensions	05	----	----	Sep 30
224	----	Higher	Big	Simulation	Wheels as cylinders	05	----	----	Sep 28
201	----	High	Big	Logic	Lap stats, game Achievements	----	----	----	Sep 17

Mantis Bug Tracker, my theme

Viewing Issues (1 - 31 / 31) [Print Reports] [CSV Export] [Excel Export]

ID	P	Size	Component	Summary	#	Updated	Progress
001	1	Big	Game	Sounds	6	2015-09-06	40
014	2	Big	Logic	Pacenotes	1	2015-09-12	60
004	3	Medium	Logic	Road splitting	3	2015-08-20	0
005	3	Small	Logic	Point to point tracks	1	2015-08-20	0
002	4	Big	Graphics	Particles	5	2015-08-21	0
003	4	Huge	Editor	Painting in editor	1	2015-08-20	0
009	5	Medium	Graphics	Sun flare	1	2015-08-20	0
006	5	Huge	Graphics	Road sides, walls	1	2015-08-20	0
008	6	Tiny	Graphics	.....		2015-08-21	0
015	7	Huge	Graphics	Visual damage and dirt	2	2015-08-21	0
010	7	Medium	Graphics	Colormap for terrain, grass	1	2015-08-21	0
007	8	Huge	Graphics	Rivers, waterfalls	1	2015-08-21	0

//TODO:

Things that aren't, weren't and ~~won't be~~ .. aren't needed.

Visual vehicle damage. Simple system done, Damage 0-100%.
Since 50% drives (flies) slower. Sophisticated one is present in RigsOfRods.
I didn't want to duplicate and too time consuming. Wanted more a better simulation.

AI, computer driving vehicle. Difficult / time consuming. Surely won't be driving better than us. In WRC rally not present anyway, always against time.

Move to **OGRE 2.1** (DirectX11, OpenGL3 and up) since recently.
Would be good to do, but gigantic, code similar, different material system etc.
More lights, good shadows, HW Instancing. Nothing for vegetation. Rest is probably there.

Point to point tracks. **Career** game mode**.**
Rivers, waterfalls. Server with track records, etc.

Rest is still in my Tasks list and Roadmap:
https://stuntrally.tuxfamily.org/mantis/view_all_bug_page.php
https://stuntrally.tuxfamily.org/wiki/doku.php?id=roadmap

Public Relations PR

Interviews, autographs, visits in workplaces…

1st interview in 2012, 45min, with 2 presenters
Floss.tv long ago, questions and answers set up earlier in email.
2nd in 2014, 15min, much worse. Both on Skype, at night 2 a.m. from USA.
One written, but shortened by half or so, full is on our forum.
In Chip (DE) magazine with CD, earlier.

Few short descriptions, each release, mainly Linux websites.
Often on freegamer blog (we have forum there).
More about PR here:
http://forum.freegamedev.net/viewtopic.php?f=81&t=5974#p61415

And a bunch of stupid free games sites. They download installer and put on their site. Know nothing about anything, steal interest from our site. Sometimes even don't include a link to us. Well, surely they can. And there are worse things.

The end.

Thanks for attention and now questions. *Screen from 1st April.*