GreaseMonkey Technology Demo

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Overview

This demo is called GreaseMonkey because, like a grease monkey (mechanic) at a racing track, you can roll up your sleeves and retune any of the cars yourself. You can drive any of the vehicles yourself while the rest race under computer control, or you can let the computer drive the vehicles while you watch.

Though it looks like a racing car game, GreaseMonkey may is an interactive environment that can be used to demonstrate the MathEngine Karma Dynamics and Collision software to simulate a wide range of vehicles and behaviors in real time.

GreaseMonkey is a demonstration of the Karma software being used in a vehicle application. For simplicity, each vehicle is constructed from five rigid bodies - one for each wheel and the chassis. Each wheel is jointed to the chassis with a car wheel joint that is based upon a conventional spring/damper system with hard travel limits. The engine is a torque motor applied to the rear wheels.

The collision detection for each vehicle consists of an aligned bounding box for the chassis and a sphere for each wheel. Detection against the landscape ties in with the function to generate a list of polygons to check against.

The 'Tyre model' is implemented in the form of a callback from the collision detection. For every contact between the wheels and the world, the callback sets up the constraint friction parameters. Polygon texture is used to discriminate between on or off the track.

Each vehicle is modelled in the same way although their individual data may be different. The computer controlled vehicles endeavour to follow a preset course around the track.

System Requirements

The suggested minimum requirements to run GreaseMonkey are:

- PlayStation 2 with standard controller

Or:

- Windows 98/2000
- PII 466 / Celeron 466
- 256MB RAM (less RAM still yields acceptable performance)
- DirectX 7
- Hardware Graphics Acceleration
- Logitech Wingman Formula Force steering wheel (recommended)

Configuring GreaseMonkey

GreaseMonkey is highly configurable. Vehicles are constructed and their properties created by editing configuration files—not by writing custom code.

Reconfiguring Both Cars and Game

GreaseMonkey provides a dialog box that allows users to choose how to run GreaseMonkey. The GreaseMonkey configuration files can be edited by using this dialog box to modify the car parameters, changing the handling.

Pressing the Reset key (**R**), causes GreaseMonkey to reread its configuration files. An external editor can be used to change these files, altering game behavior on the fly. See “Reconfiguring GreaseMonkey” on page 11 for more details.

Initially Configured for Speed and Collisions

The emphasis in GreaseMonkey is on how the cars drive, how good the collision is, and how stable the dynamics are. In real life you wouldn't have an 8 meter jump in the middle of a figure-8 racetrack. But this is useful for demonstration purposes. The cars take 8m jumps very well, and they flip quite nicely.

Cars racing in the opposite direction, races between a hotrod racing and a luxury sedan, a sub-subcompact and a roadster are not real life scenarios - but they are useful for demonstrating the Karma software.

If a car flips onto its roof, perhaps as a result of a collision, or gets stuck somewhere, it will reset itself automatically after a brief delay.

How the Cars Are Initially Configured

GreaseMonkey is continually being developed. The version of GreaseMonkey that is shipped with the current release may have cars with distinctive appearance and handling. Here are some of the different car types that have been implemented:

The **sub-subcompact** is slow, skids easily, but is easily recoverable when losing control.

The **luxury sedan** sticks to the road a bit better and accelerates more quickly. It lets you know when it's about to let go, and you can recover if you're good.

The **hotrod** has severe understeer, like a front-end-heavy V8 powered monster; you really need to saw at the wheel to drive it quickly through the corners. But, once you get the trick, it's a very predictable handler, and quite quick too.

The **roadster** is a mid-engined, light, powerful sports car. It sticks to the road like glue, but once you exceed its limits the back end will come around on you very fast. It is very unforgiving, which is a characteristic of many real roadsters.

These differences become clear if you drive each of the cars in turn.

> **NOTE:** The version that you are using may be slightly different from the documented version.

Usage

To race a car, run the executable, then press P to start the race. GreaseMonkey starts up in pause mode. You can press P at any time to pause and then resume a race. Unlike most racing games, in GreaseMonkey cars can roam freely across the track and terrain. The car attributes allow them to behave realistically; the suspension and handling mimic real-life vehicles.

Only one car can be controlled by the player. The rest are computer controlled, and use artificial intelligence to navigate the track, attempt to avoid collisions, and so forth. Assuming that the game begins with all cars under computer control, you can take control of any of the cars by pressing the appropriate keys.

If you are not using a steering wheel or joystick, you can play the demo using only the mouse and keyboard. But you won’t have as much control (or as much fun).

> **NOTE:** GreaseMonkey does not use the Karma Viewer, and does **not** support the standard user interface for Karma demos and example programs.

To see a summary of the commands available to you on your screen, press F1. Here is a more detailed explanation of each command:

Press **F1** (or **L1** on PlayStation 2) to display Information (Help) on the screen. Press it again to hide the information.

Key	PlayStation 2	Action and Description
L/R arrow or mouse	**L Analog L/R**	Steering The left and right arrow keys steer the active car left and right. You can use the mouse to steer the car.
U/D arrow or left mouse button	**Cross/Square**	Accelerator/ Brakes The up arrow key is the accelerator, or press and hold the left mouse button. The down arrow is the brakes, or lift your finger off the left-mouse button.
1	N.A.	Fixed View (Cycle through) In this view of the race, the camera is positioned at one of several fixed positions located to the rear of the car. Pressing F1 repeatedly cycles through the positions available.
2	**Right**	Drive-by View The camera positions itself where it can view the active car as it drives by. When the car drives far enough away, the camera repositions itself automatically.

Key	PlayStation 2	Action and Description
3	**Left**	Spectator View The camera positions itself in the imaginary spectators' seats, keeping the active car in the centre of the screen, and repositioning itself when necessary for a better view.
4	**Down**	Towed View The camera behaves as if it were being towed behind the active car.
5	N.A.	Helicopter View (<**Ctrl**>/ **<Shift>** + Arrow to move the camera) The camera behaves as if were on a helicopter tracking the active car. You can press the following keys to control the camera position and and orientation: <**Ctrl**> + **Left** Arrow: Orbits the camera clockwise around the active car. <**Ctrl**> + **Right** Arrow: Orbits the camera counter-clockwise around the active car. <**Ctrl**> + **Up** Arrow: Raises the camera. The limiting position is the camera positioned directly over and pointing directly at the active car. <**Ctrl**> + **Down** Arrow: Lowers the camera. The limiting position is just above the ground; as the terrain rises and falls, the camera rises and falls with it. **<Shift> + Up** Arrow: Moves the camera in closer to the car. Press and hold down the key to keep moving closer to the car. **<Shift> + Down** Arrow: Moves the camera away from the car. The extent of the movement depends on how long you hold down the key.
6	**Up**	Player Driver View The camera shows what the driver of the active car is seeing. This is probably the best view for controlling the active car yourself.

Key	PlayStation 2	Action and Description
P or F10	**R1**	Toggle PAUSE When the program starts, the race is paused. Press P to start the race. Thereafter, press P to pause the race, then press P again to resume the race.
N	**Triangle**	Cycle through cars Press N to shift your view to a different car. Press N repeatedly to cycle through each car in turn. What happens if you were in control of a car when you shifted your view to a new car? The previously active car automatically goes back to computer control. When you shift your view to a different car, you do not automatically take control of the car: the car continues to run under computer control. To take control of the car you are viewing, press M (below).
B	N.A.	Return to player’s car When you press N to shift your view to a different car, the car you left behind is still the player’s car, that is “your” car (unless and until you press M to take control of the new car). Press B to return your view to the player’s car.
R	**R2**	RESET viewed vehicle Press R to reorient the active car through 90 degrees. This is useful if you are playing the car and the car has got stuck against a barrier. (You can also reverse by shifting down through first gear and then into reverse: R also causes GreaseMonkey to reread the script files; if you changed the script files (for example by changing the mass of the chassis or the radius of the wheels), the changes will take effect.
S	**s**	Press S to turn on the time of interaction. Use this when two cars are approaching each other quickly, otherwise they can pass through one another.
F1	**L1**	Toggle INFO. Displays Help on screen.
<Space>	**L Analog Up**	SHIFT UP (Wheel R Paddle) Press <Space> to shift up one gear. This works even if your car is using automatic transmission.

Key	PlayStation 2	Action and Description
X	**L Analog Down**	SHIFT DOWN (Wheel L Paddle) Press X to shift down one gear. This works even if your car is using automatic transmission. If you are in first gear, pressing X puts you into Reverse.
L	N.A.	Toggle Auto/Manual transmission
M	**L2**	Toggle Player Control of Viewed Car When GreaseMonkey begins, all cars run under program control. This means that they drive themselves around the track, try to avoid collisions, and automatically get themselves out of any trouble that they might fall into. One of the cars is the active car, that is, the car that the camera follows. If you press M, then you will take control of the active car. If you press M again, the computer will retake control of the active car.
D	**Circle**	Toggles the level of detail of the dynamics of the viewed car. For the *High* level of detail, each wheel is modelled as a separate rigid body jointed to the chassis with a suspension joint. For the *Low* level of detail the wheels are just graphical objects and the ground contact forces are applied directly to the chassis body.

Reconfiguring GreaseMonkey

The following is an explanation of all the various keywords used in the script files for car.exe . Try changing some of the data parameters to see the effects on handling. This is NOT a definitive set of vehicle parameters and are specific to this application only. They do not have any predefined relationship to the dynamics toolkit itself. Other MathEngine vehicle demos may have different input parameters. There is very little error checking on the script files so it is recommended that backup copies are saved for reference.

Configuration File Script Keywords

Keyword	Parameters	Description
`PC_VIDEOMODE`	Horizontal res, Vertical res, Color depth	On PC you can set the default screen video mode which is displayed in the video mode selection box. If the video mode isn't available, the selection box will default to its usual settings.
`SHAPE_DIR`	Shape directory path relative to executable	This is the path to the world .BSP file.
`TEXTURE_DIR`	Texture directory path relative to executable	This is the path to all textures used in the world BSP.
`WORLD_BSP`	World BSP filename	Specify the world .BSP file.
`LIGHTS_FILE`	Dynamic lighting filename	Add additional lighting to the world at run time.
`TRACKS_FILE`	Track filename	Specify routes around the track that can be assigned to drivers.
`REAR_VIEW_MIRROR`	X pos,Y pos,W width, H height as fractions of screen resolution	Experimental rear view mirror. Only works properly on PC.
`DRIVER`	Vehicle description file, Track, Start point	Use multiple entries to create a list of cars. They can share .veh files or each have a unique one. Assign a route with a label that corresponds to a track defined in the tracks file. Specify a start point on the track. If you specify the same start point for more than one driver then the vehicles will start on top of each other.
`PLAYER_CAR`	Driver ID that player is initialized to	An ID of 1 indicates the first car on the list will be given to the player.An ID of 0 will not initially allocate any car to the player. Player control of a vehicle can still be achieved in the game by using the 'M' key.

Vehicle Description File Keywords

Keyword	Parameters	Description
`SHAPE_DIR`	Shape directory path relative to executable	This sets the current path the .DFF files. If shapes are stored in multiple locations then a SHAPE_DIR entry will be required for each location.
`TEXTURE_DIR`	Texture directory path relative to executable	This sets the current path to all textures. If there are multiple texture locations then a TEXTURE_DIR entry will be required for each location.
`CMPT_SHAPES`	Front Right, front left, rear right, rear left, chassis (.DFF files)	Add the shape files for the vehicle components in the above order.
`INTERNAL_SHAPE`	Internal vehicle shape file	If required, a separate shape can be used for the internal F6 view.
`EXTERNAL_TEXTURE`	External texture map file	Change the colors of vehicles to help identify them.
`STEERING_GAINS`	Control gain values - Proportional input, Time compensated prop input, Ang. vel. input, Slip input	Proportional input is based on the error in heading Time comp. prop. input is scaled by the current frame time Ang. Vel. Input is based on the turn rate of the car and scaled by the current frame time. Slip input is based on the lateral slip velocity of the chassis.
`THROTTLE_GAINS`	Throttle control gain - Proportional input	Proportional input is based on the speed error.
`CAR_DATA_FILE`	Data file of car parameters	Cars can share the same data or each have unique files.

Tracks File Keywords

Keyword	Parameters	Description
TRACK	Track name label	The label is used the .cfg file to assign a track to a driver. Max label length is 50 characters. Max 10 track definitions per file. Max 50 points per track.
POINT	Point id, Next point id, X position, Y position, speed, Outer tolerance, Inner Tolerance.	The first point should be the next point id for last point to make a loop circuit. The speed is the approximate speed desired at each point. To pass a point, the vehicle must be either a) inside the inner tolerance for that point or b) inside the outer tolerance and have a significant velocity component directed towards the next point.
END_TRACK	NONE	End the track description and initialize the course.

Vehicle Data File Keywords

Keyword	Parameters	Description
WHEEL_BASE	Wheel base	Distance between front and rear axles
WHEEL_TRACK	Front track, rear track	Distance between the two front wheels & the two rear wheels
WHEEL_RADIUS	Front wheel radius, rear wheel radius	Enter the wheel radii - Graphical representation only
WHEEL_MASS	Wheel mass	At the moment all wheels are assumed to have the same mass. Moments of Inertia based on front wheel radius
CHASSIS_HEIGHT_OFF_GROUND	Equilibrium chassis position above ground plane	This is the vertical position of the centre of the chassis shape
CHASSIS_X_POS	Chassis position from midpoint between front and rear axles	This is the X position of the centre of the chassis shape
CHASSIS_MASS	Chassis mass	Chassis mass

Keyword	Parameters	Description
CHASSIS_COM_UP_OFFSET	Chassis c.g. vertical offset	This is the vertical offset of the chassis centre of mass relative to the centre of the chassis shape.
CHASSIS_COM_FWD_OFFSET	Chassis c.g. forward offset	This is the X direction offset of the chassis centre of mass relative to the centre of the chassis shape.
CHASSIS_COLL_BOX	Length, Width, Height of the chassis collision box	The box is centred on the centre of the chassis shape. The spheres radius is the wheel radius.
SUSP_TRAVEL	Front suspension travel, rear suspension travel	This is the total travel between the upper and lower limits of the suspension.
SUSP_LEVEL_TWEAK	Chassis equilibrium level adjustment	Use this parameter to adjust the forward / back angle of the chassis.
SUSP_DAMPING	Front suspension damping, rear suspension damping	A value of 1 represents critical damping. 0 is not quite undamped due to energy losses within the integrator.
SUSP_EQUILIBRIUM	Front suspension equilibrium position, rear suspension equilibrium position	This is equilibrium position of the joint as a fraction of the travel, measured from the bottom.
SUSP_Z_TO_S	Front Z_to_S, rear Z_to_S	This value is the fraction of suspension travel required to generate twice the equilibrium load. This is effectively the suspension stiffness.
SUSP_SOFT	front suspension softness, rear suspension softness	This is the softness of the suspension end stops.
MAX_STEERING_ANGLE	Maximum steering angle of front wheels	The is the maximum slow speed angle that the wheels can be steered to. The maximum value is reduced as the speed goes up.

Keyword	Parameters	Description
`TORQUE_MULT`	Engine torque multiplier	This affects both the acceleration and top speed of the vehicle.
`BRAKE_MULT`	Brake multiplier	Heavier vehicles will require more braking force.
`TYRE_TRACK_PROPS`	Maximum limiting friction force (15000); Camber zone over which max. force applies (cos(angle)=0.1); Minimum limiting friction force at cutoff (0.0); Camber angle at which min. force is reached (cos(angle)=0.5); Max. lateral slip velocity(0.02); Max. rolling slip velocity(0.002); Min. slip velocity (0.0001); Rate at which slip increases with wheel tangential speed (0.0001);	These parameters apply to the contact constraint generated between the wheels and the track textures. The first 4 control the maximum limiting friction force and it's variation with camber. The second 4 control the slip parameter and it's dependence on wheel rpm.
`TYRE_GRASS_PROPS`	See TYRE_TRACK_PROPS	Same as TYRE_TRACK_PROPS but applies to everything except track textures.

Lighting File Keywords

Keyword	Parameters	Description
`Light`	None	Starts a new light description.
`Type`	AMBIENT, DIRECTIONAL, SPOT, POINT or SPOTSOFT	Defines the type of light.
`Position`	world X,Y,Z position	Position of the light in the world.
`Direction`	Light direction in degrees	Not applicable to all light types.

Keyword	Parameters	Description
`Pitch`	Light pitch in degrees	In the range -90 to +90.
`RGB`	Light RGB values	These values are relative and not limited to 255.
`Alpha`	Light color alpha value	Alpha transparency.
`Radius`	Light radius	Distance to which light effect is felt.
`Cone`	Angle in degrees	Light cone angle.
`World`	1 or 0	Apply this light to the world BSP (TRUE/ FALSE).
`Atomic`	1 or 0	Apply this light to the individual shapes (TRUE/FALSE).
`EndLight`	None	Finish light definition and create light.