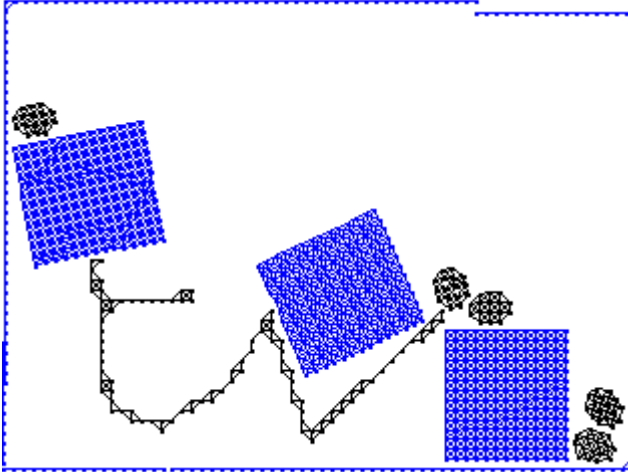


Really V0.9a

Copyright 1997 Giovanni Tummarello
(tummarel@ascu.unian.it)



screenshot from a running experiment.

INTRODUCTION

Why did I do this? :-)

Since I was a kid, I have always been fascinated by small, self-contained worlds; I remember myself (must have been 5 or 6) staring at glass marbles, those transparent ones with some ink in the middle, and thinking that it would have been so cool to touch inside them or even be there for a while :-). Today there is a lot of talk (mainly hype from the news.. while there is not much undernet) about VR that is, I think, the adult way to look at those drops of ink in the glass marbles.. Anyway.. to make a long story short.. I always wanted to create a small digital world where I could make things happen.. make them happen again with different parameters etc.. and this is my first attempt.

When I was much younger I used to program asm on the 68000 (R.I.P Commodore Amiga..) and I had no problems programming.. we had a nice flat memory model.. very little to worry about the O.S. (we would just take over the machine with the first asm instruction :-))) and I had my nice set of graphic routines so that I could make everything I wanted (me and a friend even made a game that actually got published, along with a bunch of other stuff). Then Amiga died.. We all had to turn to the PCs and.. I was pretty depressed ☺ ... developing tools were SO primitive compared to the ones we used to use on the amiga (ASMONE was the coolest editor/compiler/monitor/debugger ever seen on the face of earth) and the computer itself was everything but friendly :/ Anyway.... since Delphi has been around, I started programming again and with even more enthusiasm than before :-)) for the first time in my life I was gonna work WITH the O.S. and not kill it with my first instruction .. :-)

But let's talk about "Really"

I started developing this program about.. mmm ... not much less than 8 months ago.. I remember I was following the Physics I class (I study electronic engineering). Since this is a totally FREEWARE program and since it's overall very useless ☺ . I HAD to keep it as a low priority task and do more remunerative programming instead whenever I could (D.B programming etc :() but I finally put some time on this and came to a conclusion .. or at least came to the point where I can release a first version. First of all this is NOT version 1.0 .. this is because even if Really seems to be working nicely and the demos that I am including with this are Really Nice :-) I still think that there would be a lot to do before it actually simulates anything with some realism. See KNOWN PROBLEMS chapter :-) ANYWAY.. before talking about what still needs to be done etc.. etc. lets talk about what it is now and what seems to be working fine :

THE PROGRAM

Really is a Windows 95/NT program that will work basically on any machine.. HOWEVER the following configuration is STRONGLY recommended:

- Decent Pentium (100-120+)
- 16 megs of ram

Really is totally 32 bits so it should work very nicely on Pentium PRO machines.. (I am actually looking for some1 with a Pentium pro .. as I have never seen it working on that). Due to its internal data structure it would be relatively easy to make Really multiprocessor ready (under WIN NT) but as it is now.. it would run the same speed on a 1 or multi processor machine. LET me know if you have a multiprocessor machine and can give me a hand testing it :-)

WHAT NOW?

Ok .. load it and select "Load world" from the main menu... now pick any of the demos in there (except from HOUSE.RWD that is just a empty house for your experiments). As you loaded one, you will see another window pop up and it should contain some explanation about the experiment. In most cases. all you have to do is press the RUN button .. otherwise follow the instructions in there :-))

you will also notice that there are 2 buttons on the top of the main window:

PARAMS.. by pressing it you will get to the parameter window.. from here you will be able to set things such as gravity/ delta T/ multipl/ friction etc.. as well as other things such as real time execution values (E.G. Frames per second etc..) , number of atoms etc..

in the PARAMS (infos) window you find the following sections :

ATOMO - from here you can know how many atoms there are at (just press the UPDATE button) and some specific infos about a single atom.

ZONE - just for debugging purposes.. or for computer freaks :-) it deals with the internal data structures

ENVIRONMENT- This is an important screen . from here you can get to the bond editor (to create different materials or at least try to :-)) and set some of the runtime values : here they are :

Gravity: may be positive or negative :-)) its really fun to change it while everything runs.. normal values should be in the range of 10-40 anything more or less will result in odd things.. its pretty fun to invert the gravity .. you might want to try that...

Delta T : THIS IS A VERY IMPORTANT PARAMETER.. changing it will mean a LOT to your simulation .. this is how little a single timestep. .. no need to say that the lowest the this is (1-2) the more precise it is .. a value of 3 is also acceptable for some simple simulations 4-5 etc.. will result in a general atomic explosion (see to believe :-))

There would be a LOT to talk about this.. but I am not going to do it now.. please note that the delta T value the multipl and the fluidfriction values all have a very important role in making your simulation as stable and realistic as possible.. a very little mistake in these parameters will result in generalized bad results..

MULTIPL : this is a multiplier for the interaction forces among atoms (will not multiply gravity) this will generally make everything "HARDER" BUT! it will also cause easy resonance among the structures and therefore causing breaks and explosions.. high values will immediately cause an explosion. I have found that values between 1 and 20-25 are usually acceptable when used on standard materials (that are the ones that come with really and that have a really nice slow interaction slope) a value of 0 will cause everything to just flow.. pretty useless.. even thought many philosophers out there might appreciate this....

Fluid Friction : THIS IS ALSO VERY IMPORTANT..

This option needs to be checked .. :-)) here is why ..

Due to computational errors and to the time quantizations there is a weird problem going on in really ... energy is being created every delta T ..

I perfectly know this clear violation of what is probably the most important law in our universe :-)) but at this time all I cant do much about it.. :-)) keeping low values on the delta T will result it this energy creation to be really minimal and therefore you can forget about it for a little while HOWEVER after like 30 seconds that a simulation has been running things would get really shaking if you didn't have the FLUID FRICTION option checked :-)) a fluid friction is a friction that acts according to the speed the formula is basically $V=kV$ where K is a number less than 1. Activating that checkbox you will make it so that every atom is subject to a loss of 1/1000 of its speed every dT (or whatever value you have set for the K constant, 1/1000 is if you have this set to the standard value of 999). Notice that a 1/1000 reduction of the speed will cause a 0.999^2 multiplier on the energy therefore causing a $\sim 2/1000$ reduction on the total Kinetic energy. a 2/1000 on the speed brings a 4/1000 energy reduction etc.. values less than 990-980 basically have no sense even though are nice to try once (everything will move as under oil :-)) try generating atoms etc..) a good way to experience what fluidfriction problems can be is the demo called "Tarzan" . This is a simple thing with a wire that will fall right away and swing for a little before coming to a stop. Well it will come to a stop if you leave the windfriction values set as it is.. now try reloading it and (before running it) setting the fluidfriction to 1000 (or unchecking the checkbox) you will see the wire swing faster and more realistically.. but also you will notice that it never stops.. :-)) and start shaking really bad .. eventually resulting in a break.

NOTES : here you will find the content of the txt file saved with the same name of the .rwd data file.. it is shown automatically when you load a world and the show at startup checkbox is set. Editing this text will cause it to be saved when you save the world file again.

VISUAL : Using this menu is not really necessary anymore since you can move around the area simply by pressing in the corners of the strange icon in the middle of the 2 magnify glass icons ☺ just click around there and you will see the screen will move.

This will work at runtime as well (even better actually ☺) and you can also resize the window, causing the program to visualize more of the “world” as well as zooming in and out. Other visual options are “show links” and “show big dots” these are not here.. but in the main window.. and will cause really to visualize the links. (but resulting in a great loss of time in the visualization process, judge by yourself) Another visual parameter you might want to change is the number of calculated frames for each visualized one (also in the main window) low values will result in a visually smooth but overall slow simulation. All the values for these parameters are saved in the world file.

REAL TIME : not much more than some data about the runtime execution .. see these values change at runtime.. only one that needs to be explained is the iteration/step value.. this is the number of Square roots that the program makes ... if you think about it.. in a N particle simulation every particle could virtually interact with any other so you should check the distance among every particle this will clearly result in at least $0.5*N^2$ square roots.

Using a good memory model and assuming that particles don't actually interact among each other if they are farther than a certain set distance you can greatly reduce this number of square roots and it will become a dynamic value (based on the configuration of the system) usually in the range of KN where K usually ranges from 3 to 10 or more.. (considering that there are other)

Actions windows : From here you will be able to put new objects in the world or to act on the existing one in such ways as applying forces or speeds directly to single atoms, or acting on groups of atoms (objects) breaking their links or removing them from the world. The menus are :

Atoms :

this will allow you to put a single or multiple atoms in the world.. just select the parameters and the cords (or press random). In case you decide to put more than a atom at the same time and you do not check the “random” checkbox atoms will not be put in the very same point but will be put close enough (often causing bad damages to objects around ☺) All the parameters in this screen are also used by the “put atom here” capability of the mouse click... In other words just press the right mouse button in the simulation area and select “Put atom here” from here on .. if you press the left mouse button in the simulation area there an atom will be inserted in that point and this atom will have the color, mass and other parameters as set in this window (the atom window).

World :

From here you can just reset the simulation. Anyway loading the standard HOUSE.RWD is suggested (As it will have a solid limit to the simulation)

Blacksmith :

Use this facility to create and insert new objects in the simulation.. just press the EDIT button and you will get to the “Delusso paint” which is nothing more than a stupid paint program which looks cool but its actually very dumb ☺ no cut or paste functions are available (even if the icons are there).. available functions are : Freehand drawing with different pen sizes , straight lines, straight polilines, squares, circles, area fill routines, color selection. Simply draw it there (do not make too many details.. as it would be useless.. ☺) and , set all the parameters as you want (give it a name if you wish .. it will help you in the object manager) or leave them as they are then drag the object starting from the “Drag from here” platform to the main simulation screen.. as you move the mouse carrying the object you will see it flash in the screen (still in a solid version) as your release the mouse (you will have to wait few secs if you are on a low memory machine) you will see that the objects will be inserted in the world all made with standard atoms.

To create more complex objects (like those that are in the experiments that I provide) simple create simple objects and glue them together (see interact) or remove particular atoms after you created them (so to make holes in the material etc.).

You can make wires simply by putting very thing rectangles in the world.

To make a smaller version of the same object just zoom in the simulation area.. and drop it again.. by doing this it will look the same size, but since on the screen but it is obviously smaller than the others you dropped with no zoom factor.

Object manager :

This will allow you to remove , stop or disintegrate object that have been previously inserted in the world. Just select the object you want, select the action to perform and press the button...

Interact :

From here you will be able to interact with the single atoms in the simulation (or even with entire objects) by applying a force to them or forcing a speed (try it to see the difference, be very gentle when applying a speed) Simply select one or more atoms in the simulation screen by going in selection mode (right mouse button in the simulation area and then chose “select/deselect”) and clicking on the atoms. Selected atoms will appear bigger if the “big dots” option is not set. The select either force or speed and check the “Apply” checkbox. Once you have done this all click in the white square and see a vector moving as you move the mouse in there with your left button pressed and (at the same time) see the reaction of your action directly in the simulation screen (everything must be running .. of course).

There are other actions you might perform on the atoms from here... but you can do them as well from the right mouse button menu in the simulation area (like link 2 atoms together , remove atoms , make it fixed, make it movable etc..

Wind :

This is still under development and I decided to disable it.. it could give “Really” its first real application, by allowing the study of some simple aerodynamics (CX stuff etc..) but will require some work to create a stable flow of atoms.. (not too much work after all...) so if you are interested in this.. please E-Mail me and I will be glad to work on it.

Other things :

Different materials..

You can make everything harder simply by raising the multiplier value in the parameters window, but you might also want to create different materials.. the bond edit tool will allow you to create them by setting the response curve to the normal (blue) or tie (red).. normal is the force that an atom will give to the atom next to it when this comes too close, and tie is the force that the atom will give to the atom tied to it when this goes too far away. You should imagine these 2 as one behind the other (the red one comes after the blue one. The RestP is the Rest Point.. it is used when inserting objects.. atoms are put at the distance that is the RestP distance when the object is first created. It is not hard to understand that this should usually be set in a place where the actual reaction force is 0 (that is like in the first material defined. The very end of the blue slope.. where the value is close to 0) . if this is not true the material will be very unstable and even explode when inserted.

The break point refers to the red slope and is simple the point after which the bond will break. Setting this much on the right will cause the material to be more resistant.

In my personal experience , creating realistic materials is not very easy.. and this is certainly a part of this software that will undergo major changes in the next releases.. that is interested in it and sends me some support E-Mail ☺.

Bonds..

There are 2 kind of bonds that are generated, the straight one and the diagonal one.. the diagonal one is square of 2 times longer than the straight one and since the slope used for it is the same (just stretched a of square of 2) the diagonal bond is generally a bit softer.. this is somethings that needs to be better taken care of and it will in future relelases.

The maximum bond length is not a random value, matter of fact the internal data structure is heavily optimized to deal with materials that are like those i provide with really (generally with the RestP at the very right of the screen).

Known problems,hidden features, future versions & possible applications.

If you went trough the examples I provide.. you have probably appreciated that , even if these simulations don't really look "Realistic", at least they seem to make sense ☺. The main problem you might have experience is that everything looks a bit (a big bit actually) too soft. Another problem is that if you don't want to experice unwanted "explosions" and terrible vibrations you have to somehow keep the "fluid friction" on (even if set at a low value). In the end you could say its overall pretty slow as well ☺. Now, one thing I want to say is that I feel that these problems are somehow linked together and that everything could be strongly improved but this would resoult in a much slower simulation. As an example.. just think how little it is the gravitational interaction (at atomic level) compared to the Coulomb's forces in the real world. Well, in order the have an acceptably fast simulation these two forces were made much more similar. Same thing goes for the "explosions" that occur when the speed of the atoms involved are much too high for the deltaT value (what happens is that basically a atom that was supposed to be "slow" appairs too close to another one and therefore receives a force that is much too intense than the one he would have receive if the step had been smaller.

As for the overall precision, the math used in “Really” is 90% integer math (Even though big integers.. = $+2^{31}$). This should make everything faster (even though i didn't actually try anything different..) but also results in loss of precision.

Many things could actually be done, but what I really need is some supports from you people out there in the for of any kind of feedback... ☺

I will be very glad to work more on it and to make it more capable of more specific and accurate if anyone contacts me and asks me to do so for some particular purpose. So please let me know.

What could be the next releases ?

- 1) Multiprocessor support .. to run on windows NT workstation with multiple processors at a much higher speed.
- 2) Overall faster ! All the code is in standard object pascal with no ASM at all.. and we all know what ASM can do in tight loops conditions. ; Also a good speed enhancement (20-40%) will be obtained as soon as i change some internal processing structures (as soon as i have some more time).
- 3) Solid bodies ! there will be tha possibility of inserting bodies defined as “very solid”. These bodies will not bend under any condition but still probably break under high forces (definable). The would be very fast as well and would interact with the standard ones..
- 4) Larger area
- 5) A correct wind simulation for an approx CX calculation etc.. (mainly for educational purposes)
- 6) A correct model for standard friction and therefore it will make sense talking about temperature of the bodies (that will raise due to friction).
- 7) Other thermodynamic applications like heat conduction etc..

What could it be used for ?

As it is.. not much i think .. it is more of a programming exercise, but like said before i will be glad to work with any1 that needs a more “realistic” simulation about anything.. so please let me know..

However I think that maybe it could be used to teach some basic standard Physics (kinematics etc..) especially in High Schools etc..

Hidden features :

There are some hidden features (most of which pretty useless) ☺ but there are some interesting ones as well. Really has a built in movie creation facility .. but it actually doesn't work now.. and I dont think I will fix it before releasing this version. Please let me know if you need this.. and i will fix it and release it. Movies made with really can only be played using Really as well.. .

There is also a movie file (.pip) recovery utility that I had to program in the old days when Really was so slow i had to make movies all the time to see something and was so instable that most of the time it would crash leaving the movie file it was recording pretty corrupt ☺..

[To get in touch with me.. please use the following ways:](#)

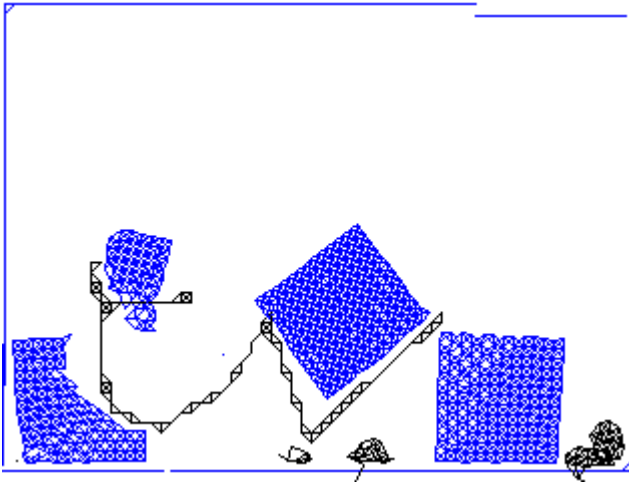
E-Mail : tummarel@ascu.unian.it or genialog@mbox.vol.it
(I`d say write to both of them .. as none is very stable)

s-mail :
Giovanni Tummarello
Via Fornetto 57
60131 Ancona
Italy

Tel. +39-71-43081 (It`s either me or my answering machine here..)
fax +39-71-42250

Homepage : <http://ascu.unian.it/~tummarel/personal.html> (for general informations, pictures and other software that I made, all freeware, shareware)
Really homepage : <http://ascu.unian.it/~tummarel/really.shtml>

Now see what happened to the experiement I showed at the very top of this document after I greatly increased the gravity for some time and then put it back to normal (notice that the black balls were defined much heavier than the blue cubes and some of them went out of the screen ; also the “big dots” visualization has been turned off)..



Thanks again for reading this far and for taking a look at this software.. let me know ! Any feedback will be greatly appreciated and will help me develop future and more useful versions.

Something else.. ☺ if you feel you like this program (the interface, the programming, the idea or whatever) and really want to offer me a scholarship to study in the States or a job as a programmer .. let me know ;-).

Giovanni Tummarello