Tutorial 12
Creating Explosions
Chaotic sound events production

written by Stephan Schütze

Overview

Explosions are chaotic by nature. An event triggered either artificially or as a result of natural causes or a scientific process result in a violent series of reactions. The sound of an explosion is actually a combination of dozens or even hundreds of small sound events that combine to create the overall effect. The sound events involved will depend on the materials present in the explosive event as well as the environment in which it takes place.
To create an explosion sound it is necessary to define what materials will be included in the explosion event and what occurred to generate the reaction. This tutorial will break down some of the elements of explosions and discuss how to use this knowledge to create effective sound effects.

First I want to attribute one of the main reference sources I have used over the years to better understand the process of creating sounds and explosions in particular as this sound designer and author has contributed great things to the creation of sound effects. David Yewdall is a Hollywood sound designer who has worked on many films with great sound, and his book Practical Art of Motion Picture Sound is an excellent source of information and inspiration for anyone interested in sound design and production. I cannot recommend this book highly enough.

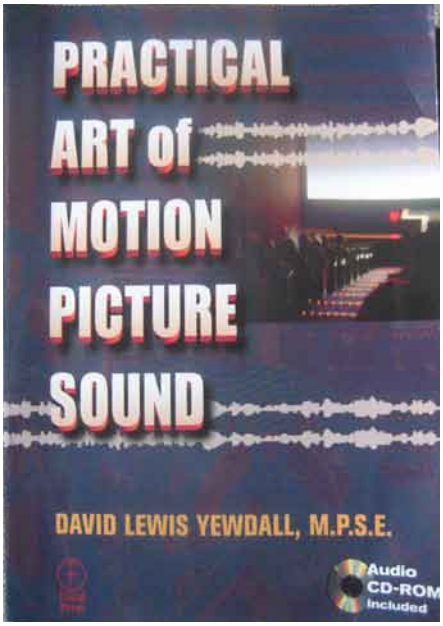

Figure 1.
Practicle Art
of Motion Picture
Sound
by David Yewdall
This is an excellent book for anyone interested in sound design, recording and creation. This book has been a constant inspiration to me over the many years I have been working with sound. It includes many real examples of how to approach unusual sound creation issues.

De constructing explosions

To create something it is necessary to understand the individual components and how they are combined to generate the final result. With explosions this means understanding how such an event is generated. Wikipedia defines an explosion as follows

An explosion is a sudden increase in volume and release of energy in an extreme manner, usually with the generation of high temperatures and the release of gases. An explosion creates a shock wave.

http://en.wikipedia.org/wiki/Explosion

From a sound perspective the release of energy of an explosion is only the most basic element of the overall event and often too much attention is placed on this one aspect at the expense of other parts of the overall sound event. The sound of a release of energy on its own can sound very flat and unexciting. It is the resultant shock wave and its effect on the immediate environment that generates interesting sound material.

Figure 2. Fuel Explosions triggered under controlled conditions (Image taken from the internet)

Years ago I spent several years in the Australian Army, and had to undergo basic training as all army personnel do. Part of that basic training was the use of standard army weaponry which included hand grenades. This was of course done on a special training range under strictly controlled conditions. The range itself was flat ground with no objects that could be affected by the explosions. As a result the only sound being generated was the basic explosive bang of the grenade itself and its effect on the ground which was dirt.

Don't get me wrong here, the explosion was incredibly loud and everyone wore hearing protection, but the explosion was basically a very loud bang, a very basic, short sharp impulse. Effectively the same as a balloon pop but much louder. From a sound design point of view it was a very boring sound and would not be that useful by itself. It is often what accompanies an explosive bang that makes for an interesting sound.

So what does make a good explosion sound?
If we take the example of a typical Hollywood style film explosion we can analyse what goes in to making the explosion more interesting. For this we will use the example of a clichéd Hollywood car explosion. The make and type of car is not important, and neither is the cause of the explosion. If we slow the event down so we can see each stage we would get the following.

•Initial explosive release of energy (either gas tank, a bomb or other cause) *-Bang*

•Shockwave as energy radiates outwards causing massive sound waves *-Whoosh*

•Initial effect of shockwave on the car interior; plastic, metal breaking -Crunch

•Continuation of shockwave travelling outward; metal tears, glass shatters *-Smash*

•Chaotic combination of all previous events as outward force continues *-Crash*

•Optional further effects of elements depending on size of explosion

•Movement of main body of car, either shaken or entirely relocated *-Scrape/Bang*

•Major detached pieces of car coming to rest *-Crash/Bang*

•Minor fragments coming to rest (amount and duration depends on event) *-Tinkle/Clink*
•Shockwave travels on through environment; echoes or reverb *-Whoosh*

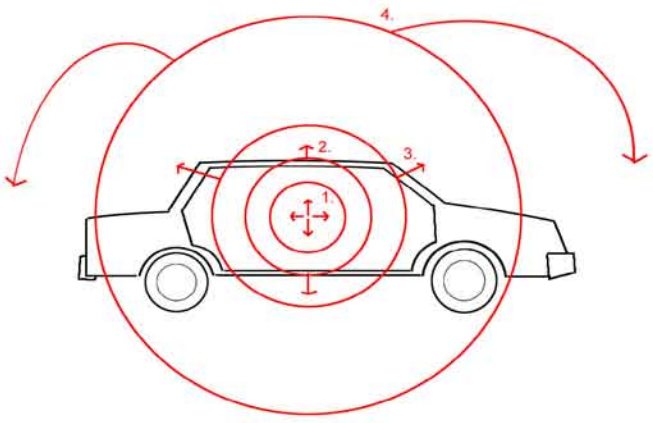

Figure 3. Stages of a car exploding
1. This is the initial release of energy. The relevant sounds will include the initial impulse and the beginning of the shockwave sound.
2. This is the first stage of reactive sounds. Objects and materials inside the car begin to move from the force of the shockwave. Metal and plastic bend and break, material rips and objects collide.
3. At this stage the shockwave and objects will move beyond the car. Glass will shatter outwards, the body of the car will be torn apart and objects will be pushed away from the car as the shockwave continues to expand.
4. The final stage is where the shockwave will fade out as it looses energy; objects and pieces of the car will fall to earth having lost the energy of the shockwave. Everything should return to a state of rest. (The car may be on fire at this stage but this is a separate event)

All of the stages in figure 3 would occur in less than a couple of seconds, but it is the combination of so many drastic events combined that create the sound we hear. This example is of a single explosion on a single isolated object. Were the car to be placed in with other objects there would be even more sub events added. The panels and parts of the exploding car would interact with other objects such as other cars around it, this would cause secondary and even tertiary events as other cars are effected. Further crashing of metal and breaking of glass would be very likely in these circumstances. In the case of a grenade it would normally be used somewhere where it would destroy other objects, so the initial isolated bang would be combined with shrapnel and a shockwave impacting and breaking other objects so we would get similar sounds from metal, glass and stone as they were damaged.

The above list is a useful breakdown for any explosion to help establish what sound material is needed to create the overall sound effect. The cause of the initial bang will need to be established to know what sound to use as a bomb would generate a single loud impulse but an erupting fuel tank would have a longer sound much like a gas flame igniting. The sound of a firearm like a large calibre pistol or shotgun could work quite well for the impulse of an explosive device detonating. Something as simple as a gas cooker being lit could provide the sound of a gas tank explosion once the sound was pitched down to a suitable range.

I am lucky enough to live in a city where the local casino has giant gas flames that erupt every hour on the hour and so a sample of those being triggered works perfectly for a huge gas or fuel igniting sound. (Look in the library for them) They are a horrible waste of resources but produce a fantastic sound.

Figure 4. Flame towers at Crown Casino Melbourne

Once you have sourced a good sound for the initial energy release you will need sounds for all the material components that make up the object that is exploding. For a car this would mean metal, glass, plastic and maybe even the sound of tyres impacting on the ground. For a house it might include wood crashing and splintering as well as bricks and concrete and the previously mentioned metal and glass. Having a good selection of each of these material sounds allows for a variety of explosion events to be created. When working to a film or TV clip it can also allow you to exactly match the sequence of events in an explosion clip by providing suitable sounds to each element of the explosion event. Arranging your source sounds into different folders can make it easier to work with the different elements when constructing sounds. This is not always worth the time spent, but because explosions can utilize a lot of different material sounds from different sources it can be useful. Think of it like laying out different colours on a palette so they are ready to mix and paint with.

The list, of events in an explosion, provided earlier is useful as a timeline for constructing an explosion sound effect. Working through the list in order allows for the sound to be built up one element at a time. You will obviously need a sound editor with a multi track function to be able to combine the many elements that go together to create an explosion sound. Labelling each track and using it for a specific element can avoid confusion as the sound becomes more complex.

In many cases you may need more than one track dedicated to a particular element, just add more tracks as needed but keep them labelled and grouped together. A well constructed multi track session for explosions can be used over and over as certain elements can be muted and new ones added. In this way a session created to make a good car explosion sound can be quickly changed to be a house explosion. Simply open up the old session and save it under a new name, then mute any of the elements you don't need and add new ones. Finally change or move in the timeline any of the elements to tweak the final sound for your exact purpose. This can save a lot of time as the initial setup and layout times are greatly reduced. This method won't always be appropriate but it can often save time.

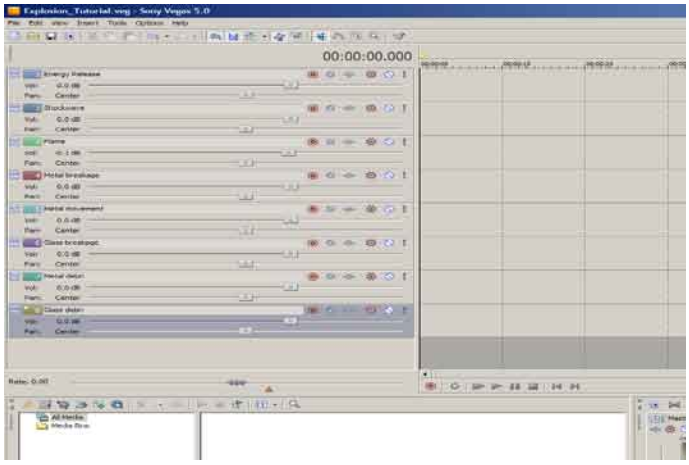

Figure 5. Allocating Tracks in Sony Vegas
While designed predominantly for video editing Vegas is a very useful tool for multitrack audio editing and creation.
Allocating tracks to particular sub events and clearly labelling the tracks can make editing much easier once all the sound material has been inserted. In this manner a multi track project can also become a template for future projects which can save alot of time.

I will generally start with the initial release of energy and the resulting shockwave. There is no correct order in which to create a sound effect, but for me getting these two elements working well makes the rest of the process easier. Depending on the size of the explosion I may combine several sounds just to create the initial impulse. As mentioned before firearms being discharged are a good source of bang sounds, but any loud bang can be suitable. Kicking a large cardboard box or a big steel plate or even smashing a metal trash can onto the ground can all produce different impulse sounds that can work well as the basis for an explosion; even a hand clap recorded and pitched down might work. Layering several sounds can add depth to the sound and generate an impulse with a broader range of frequencies. The sound of a fist hammering against the metal of a children's slide in a playground can produce a strong metallic impact sound with some interesting reverb. And of course a recording of any real explosive event would be useful. Fireworks, construction demolitions and military exercises could be sources of material.

When combining several sounds to make a larger element, be careful to not swamp the sound with too many events. Just like mixing too many colours together in a painting creates a muddy brown mess, combining too many sounds together can cause the final sound to be unclear and sound muddy as well. I will often play a sound session over and over muting different tracks each time to see how much I notice each track being muted. If I cannot tell if a track is playing or not then either all the other tracks are too loud, or I do not need that track and I may as well remove it. Also when I add a new sound file to a track I will start with that track set to a high volume so I can hear the new sound I've added. I will then gradually reduce the level of that track more and more until I can barely hear the new sound. In this way I am lowering the track "into' the mix rather than sitting it on top of the mix if it is left too loud. Obviously as you add more and more sounds some will be lost or even not needed. Try not to leave in sound material you don't need because it can add to the mud.

Using the analogy of painting again, while the sounds categorized in different groups are like paints on a palette, when they are combined to make a new sound it is the frequencies that should be thought of as the different colours. Combining a mix of different frequencies can help you produce a good final sound, having too much of any one frequency area can make a sound heavy or shrill. David Yewdall in his book says that for him it is not the sub frequency rumble, or the low frequency bang that produces great explosive events, it is all the debris and particles that come after (most of which will tend to be high frequencies) that add clarity and punch to a sound. Since reading his book years ago I have approached both location recording and sound design with this in mind and I have to say I completely agree with him. It is not the low bang or thud that makes a gunshot or thunder strike so powerful, in fact thunder at a distance is almost entirely low frequency material and it simply forms a basic rumble. It is when thunder strikes directly overhead that you hear the full range of the sound and it is as if the sky has been torn open, a combination of a powerful low end rumble combined with a high pitched tearing sound that creates such an awesome effect.

There are tools available to help in how you balance out the sounds you create. Obviously our ears are the best tool, and we can use these to find out if certain sounds are too loud or too soft in a mix. Experienced sound designers can also tell if the frequency balance in a mix is good as well, but it can take many years to be confident in this skill. For the rest of us, a spectrum view quickly displays the frequency makeup of a sound. By mixing down a test version of the sound you are working on and viewing it in a spectrum view you can quickly see if certain ranges of frequency are over represented in the mix.

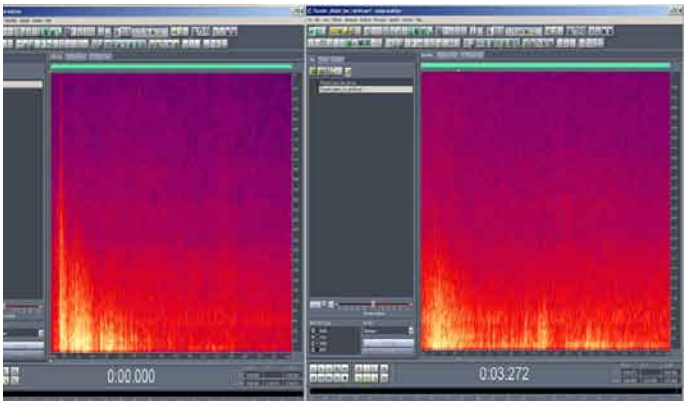

Figure 6. Spectral view of two thunder sounds
Spectral view in Adobe Audition allows you to see the range of frequencies in a sound and their relative power levels. Dark colors represent low power levels and as the power increases the color shifts from red, through orange and yellow to white at extreme levels. In the above diagram the image on the left is of a clap of thunder directly overhead. This sound contains far more high frequncy sound material. This is represented by the yellow spike on the left hand edge of the image. This spike travels much further up the screen than the image on the right hand side. Both have very high power levels inthe lower frequncies represented by bright yellow at the bottom of the screen.

When constructing a complex sound like an explosion it is good to have a basic plan about what sounds to add and where. The diagram in figure 7. can be a useful guide as to what order events will occur in. But plans and guides should not prevent a creative process. Lay out the tracks as planned, but feel free to move the events in those tracks around. Ultimately the goal is to make a good sound effect, and as long as it sounds appropriate for its purpose don't be afraid to be creative. Muting and soloing various tracks is good for checking balance and frequency content, but it is also really good for the creative process. Mute or solo multiple tracks, or groups of tracks to isolate certain elements of the sound. You might find a combination that you like better than all the sounds mixed together. Accidental combinations can quite often create the best sounds, as they are not what you would normally think of.

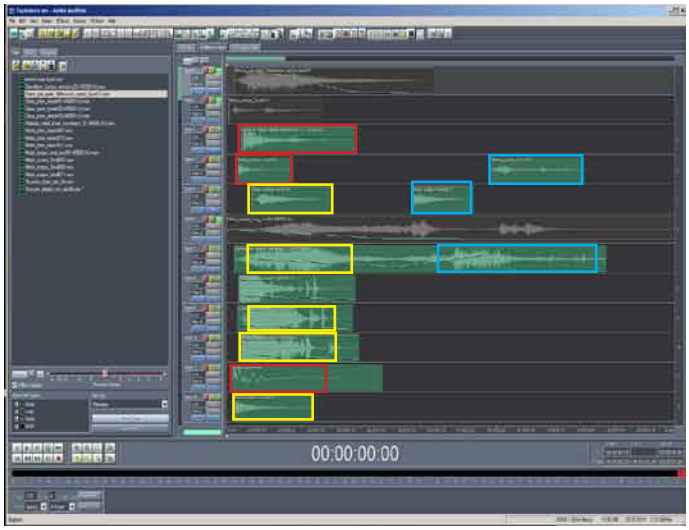

Figure 7. An explosion multi track project
Red: Initial impulses
Yellow: Stage 2 and 3 reactions
Blue: Stage 4 debris

This process applies to any explosive or chaotic event. To create the sound of an underwater explosion the initial impulse could be the sound of a bubble in water, pitched down considerably to make it appear very large. Removing the high frequencies and increasing the low frequencies of this sound can create the illusion of the sound occurring underwater. Then add splashing water from a swimming pool or any body of water. The splashes represent the first stage reactions as the shock wave moves outwards. Smaller splashes can be used for the second stage reaction. (In open water there is only water to react, no other materials) The third stage consists of the many small drops landing back in the water after a large splash and the hiss of the water as it settles back to a state of calm. This is the water equivalent of debris. All of this material could be sourced by standing in a swimming pool and using your arms to create splashes. Pitch shifting and clever editing can combine this material into a giant underwater explosion.

Figure 8. Explosion at sea
In some environments there are no other materials or objects to react to the shockwave. An explosion at sea would consist of only the sound of water moving (although extremely violently in this example). The shockwave itself would produce a considerable amount of the sound of this explosion. (Image taken from the internet)

Like any creative process it is in the details that make the difference between a good result and an average result. When I add some of the finer details to sound effects I will sometimes go to extremes to get the result I am after. One explosion sound I created needed 65 tracks to be able to contain all the debris sounds of glass shards and pieces of metal dropping to the ground after the initial explosion. The good thing about this type of sound project is that you can start small and build up, and each level can produce something usable. Once you have created a basic explosion impulse that you like, try mixing it down and see if it is usable. If it is then save the multi track session under an appropriate name, and continue adding to it. You can add layers and layers of events at all stages to create a bigger sound that contains more elements. Just save each version under a different name and you will have a variety of explosion templates. You can continue adding to the project as long as you have material and a computer capable of dealing with the amount of information.

Making an explosion
While the schaud.com library contains lots of explosion sounds and even more of the basic elements that allow users to create their own explosion sounds one of the main aims of this site is to encourage people to create their own sounds and help them to understand the process. To that end I will describe how to create an explosion sound using any type of recording gear, recording the kind of things that should be easily accessible to most people. This is less about trying to create the most amazing explosion sound in the world and more about going out and doing it to help understand the process. I will list the various elements and discuss ways to create them.

Initial impulse
As has been previously mentioned, the initial bang impulse can be provided from various different sound sources, but not everyone can easily record giant gas flames or firearms being discharged. As an alternative you can use the following.

Balloons
Balloons are really good for creating a sharp impulse sound. The sound of a balloon popping is essentially the same as a gun shot but on a smaller scale. The ability to alter sounds with pitch and volume means it is possible to increase the scale of a recorded balloon sound. I have found that using water balloons gives a pretty good result. They don't inflate as large as party balloons, but the rubber is thicker so I find they make a good short sharp bang when they burst. Don't hold them too close to the microphone because just like a gunshot they generate a very high SPL sound and will max out microphones easily. You can actually use a balloon to generate a nice shockwave sound as well. If you record you balloon pop outside, but somewhere with close by buildings you can capture a good echo effect.

Cardboard box
A large empty cardboard box is a great source for interesting impulse sounds. The bigger the box the deeper it will sound. A refrigerator box is ideal. Turn the box over so the open end is on the ground and place the microphone inside the box on the ground. Again you will need to monitor the levels carefully. Hitting the box with you open hand or fist will produce a hollow booming sound, but you can also use other objects to hit the box. A pillow or cushion will create a dull thud, while a bat or stick will create a sharper sound. Be careful not to hit the box so hard that you break it.

Metal objects
Another option is to find a children's playground that has a metal slide. The wide metal sheet that children slide down will also reverberate well when struck. Again you need to be careful not to damage anything. Using your fist can generate a fairly good metallic echo, place your microphone on the ground beneath the slide. Using a rubber mallet can produce a more powerful sound without damaging the slide (A metal hammer is not a good idea as it will dint the slide) Even a baseball or other hard ball bounced on the slide can produce a good impulse sound. Any other large metallic surface such as a pipe or metallic plate can produce a good impact impulse as well as an echo depending on its location. Experiment with different materials and see what results you get. You could also try a toy cap gun or even an athletics starter pistol that uses caps.

Figure 9. Childrens Playground as a source of sounds
A typical childrens playground can be a great source of sounds. Metal, wood, rope and plastic all in one location are ideal for banging, creaking, clanking and thumping sounds. The best time to visit a playgorund is very late at night. Firstly you won't upset the kids by getting in their way, but secondly and most importantly you won't have to worry about noisy children ruining your recording.

Major material impacts.

The best place to record things breaking is somewhere like a junkyard or rubbish area where everything is broken anyway and no one is going to mind you dropping or kicking things. I try and isolate materials and record them one at a time. So if I find a good piece of wood to break, I will break it with other wood, or just against the ground. This way I have a clean wood sound. If I break the wood with a brick, then the sound is a mixture and wood and brick which limits its use. Wood, metal and bricks are pretty easy to come by. If you are having trouble finding metal to bang on then get a metal rubbish bin, they are great to bash against the ground, or hit with a hammer or a wooden plank. I have one in my studio I keep especially for bashing up. It's the cheapest piece of sound equipment I own, and even though its all dented and bent I can keep using it forever. If you want to reduce the hollow metal sound it makes stuff it full of cushions or pillows before you hit it, then it should produce a dull metallic crash or thud.

Figure 10.
Harold the stunt bin
A cheap metal rubbish bin (or trash can for those of you in America) can be an excellent tool for sound effects recordings. Dropped, thrown, hit, jumped on or rolled can all produce interesting sounds. Filled with different materials can provide even more options for recording raw material. Substituing practical, and more affordable, objects to create sounds of other things is a common technique in sound design.

Anything small is suitable for both major impacts as well as debris sounds. Pitch shift the sounds down a little to make the objects sound larger. Tin cans, old bits of metal, toys, bricks and stones can all work really well as debris. Drop them on the ground near the mic. The real trick is to record so many that you have dozens and dozens of different pieces of debris falling at the end of your explosion sound. Try dropping lots of different objects and listen to the types of sounds that are created and imagine what other sounds they might allow you to create. Any time you hear a sound listen carefully to the different elements of that sound and think about how the sound might be usable to create new things.

Sound design is as much about listening and thinking as it is about recording. Watching films and TV and listening to the sounds you hear, or walking anywhere and listening to the environment around you is one of the main aspects of being a sound designer. Listening will allow you to hear interesting and useful sounds that you might be able to use in the future, but more importantly listening helps you understand how sound works in the world which is vital if you want to be able to create realistic sounds.