Statistical Orchestration

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This note describes the process I used to automatically orchestrate my compositions prior to having a computer means to perform true orchestration.

In 1991 I decided to invest in a high quality keyboard synthesizer. I went to a local music shop with some music in hand and told the salesman that I wanted to try out the top of the line models he had in the shop. I did not want to waste any time with a cheap model. He told me that he had a brand new keyboard (Korg 01W/pro) that had not even been unpacked yet and that one might be a good one to try. He unpacked it and I spent the next hour playing with it. It was a sampler type of synthesizer so its orchestral instrument sounds were very true – although at that time computer memory was quite expensive so the sampling had been reduced to the absolute minimum. The instrument had 32 individual synthesizers which could be combined in various ways and could typically sound eight or more notes simultaneously depending on how many individual synthesizers were required for a particular instrument sound. It also had eight channels of combinations where different instruments could be sounded simultaneously or layered or split. It even had the ability to simulate the acoustics of a concert hall and with stereo spread of the instruments. I was highly impressed and purchased it. It turned out to be one of the best items I have ever bought, as over the years I have enjoyed a lot of great use and accomplishment with it. It still works well as of this writing although some of the touch sensitive keys don't work quite like they used to.

The instrument had a MIDI interface and I purchased a popular MIDI control computer program known as Cakewalk (now known as SONAR) to be able to play multi-instrument orchestrations via the MIDI port. After considerable effort, all attempts at sending multiple channels of MIDI data for different instruments failed. I could only send a single channel. Then I found the fine print in the Korg manual that it only accepted a single channel. So even though the synthesizer was capable of making many simultaneous instruments via its keyboard it could only sound a single instrument type via the MIDI port. What a disappointment.

That single instrument could be a programmed combination of up to eight different instruments. There were examples of orchestras and various ensembles in the Korg library. None of the library orchestras were appealing to my needs. It occurred to me that by using layering and splitting that a crude orchestra could be assembled that could work to what I needed. The instruments that would sound would then be a function of the MIDI note and key velocity. That realization was the birth of what I refer to as statistical orchestration – a given MIDI note and key velocity is probably a certain instrument. In addition to being able to play an orchestra via MIDI it would also be possible to play an orchestra via the keyboard. Being able to play an orchestra on the keyboard was a great inspiration and tool.

The Korg has a large library of 200 individual instrument sounds and for a number of instruments there are several libraries with various differences. I went through the libraries and picked the instruments with the sound characteristics that best fit what I wanted to do. In

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building an orchestra I had a general concept of a full orchestra with a Wagner type of sound so that drove my selections.

Although I could pick only eight instruments, each instrument could effectively be multiple instruments in the same family as any note within the electronic range of the synthesizer could be played even if such a note was not playable on a real instrument. This meant that a single string sound could be a violin, viola, cello, or double bass depending on what note was played. Of course a violin sound played in a double bass register is not the correct double bass sound – but it is not too wrong – and I do not have a choice. A single clarinet sound can be either a standard clarinet, a high E-flat clarinet, or a bass clarinet depending on the note. A flute sound can be either a flute or a piccolo. This means that the eight instrument limit really expands to cover many more instruments approaching a full orchestra although without the double reeds.

The concept is that:

- At low to medium volume levels the sounds are strings plus clarinet and flute.
- From medium to loud volume levels the sounds are strings plus brass plus flute.
- Around the transition point it is possible to have both woodwinds and brass playing simultaneously on different parts.
- For loud levels the brass dominates plus flute/piccolo for the highest notes.
- The tympani sounds at the highest levels (126 and 127) and some instruments are dropped at level 127 for tympani only.

Limitations:

- The concept tends to be brass heavy – a true orchestration would not use brass so much.
- Only loud tympani levels are possible. Soft tympani rolls are impossible.
- Loud clarinets or flutes are not possible.
- Soft brass is not possible.
- There was no way to include the double reeds.

Characteristics:

- At very low sound levels the strings dominate as woodwinds are barely audible.
- At medium sound levels the woodwinds dominate although strings are definitely audible.
- At the lowest end of loud levels the strings dominate the brass although brass is definitely audible.
- At the highest sound levels the brass dominates although high flute/piccolo and low strings are definitely audible.
- It is a challenge, if possible at all, to achieve proper balance between instruments at various sound levels.
- Although brass and woodwinds are on different sound level layers all can be heard simultaneously by assigning different sound levels to different notes.
- The orchestration is necessarily thin – i.e. minimal instruments. This results in easy separation of different parts and is a good guide to what someday will become full orchestration as it avoids a common problem of over orchestration.
- The variation of orchestral tone colors is very limited but provides a general idea of what full orchestration might sound like.

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The result has been very good. I have posted a number of mp3 recordings on my web site made using the above method and in a number of examples one might think the music was fully orchestrated. In other cases the orchestration is obviously wrong but not very wrong. The results are very listenable drafts of what someday will become true orchestrations using the notation program, Finale.

The following format is used to list the eight instruments of my statistical orchestra:

Instrument:	Korg library name (Korg library address): Used for instruments
Playing note range:	Low – high as played on keyboard or through MIDI. (C4 = middle C)
Sounding note range:	Low – high as transposed (typically up or down an octave)
Velocity range:	MIN (1 – 127) to MAX (MIN – 127), note velocity range
Output level:	can range from 0 to 127 – set low enough to prevent clipping on loud
Stereo Span:	can range from 9:1 for extreme left to 1:9 for extreme right

Some of the original settings shown in parenthesis were later altered to reduce distortion that would sometimes occur on some large loud chords and also to correct some instrument imbalance. Achieving balance was quite a challenge.

Instrument:	**Brass 2 (B62): Used for tuba, trombone, and horn**
Playing note range:	C2 – G#4
Sounding note range:	C2 – G#4
Velocity range:	90 – 126
Output level:	45 (original level was 80)
Stereo Span:	7:3 (original was 6:4)

Instrument:	**OrchTrpts (A12): used for trumpets**
Playing note range:	A4 – E6
Sounding note range:	A4 – E6
Velocity range:	90 – 127
Output level:	45 (original level was 75)
Stereo Span:	4:6 (original was 5:5)

Instrument:	**Tympani (B39): used for tympani and bass drum**
Playing note range:	C2 – C4
Sounding note range:	C2 – C4
Velocity range:	126 – 127 (original was 127 – 127)
Output level:	45 (original level was 85)
Stereo Span:	9:1 (original was 9:1)

Instrument:	**Bass&Cello (A47): used for Bass and cello**
Playing note range:	C-1 – E3
Sounding note range:	C0 – E4
Velocity range:	1 – 126 (original was 1 – 127)
Output level:	45 (original level was 80)
Stereo Span:	8:2 (original was 3:7)

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Instrument: **AnalogPad (A27): used for violin and viola section**
Playing note range: C3 – G9
Sounding note range: C3 – G9
Velocity range: 1 – 127
Output level: 45 (original level was 75)
Stereo Span: 2:8 (original was 7:3)

Instrument: **Clarinet (A73): used for all clarinets**
Playing note range: F2 – C6
Sounding note range: F2 – C6
Velocity range: 1 – 89
Output level: 45 (original level was 85)
Stereo Span: 6:4 (original was 3:7)

Instrument: **Flute (A83): used for flute and piccolo**
Playing note range: D4 – B6
Sounding note range: D4 – B6
Velocity range: 1 – 89
Output level: 45 (original level was 75)
Stereo Span: 3:7 (original was 4:6)

Instrument: **Flute (A83) an octave lower: for flute and piccolo**
Playing note range: F6 – G9
Sounding note range: F5 – G8
Velocity range: 1 –127
Output level: 45 (original level was 75)
Stereo Span: 2:8 (original was 5:5)

Examples:

Although the intent was to use the Korg to instrument my own compositions, I adapted several favorite Classical pieces. Because everyone is very familiar with the true orchestral sound of these pieces they make good examples of what can be done with my statistical orchestration.

Keep in mind that all of the performances are via a single MIDI channel played once through the Korg. They are not merged recordings of different instruments. My program on the Korg performs the splits and layering and stereo spread of the instruments as the MIDI data arrives. If you are manually entering the URLs note that there are underscores (not spaces) between the words of the file name.

http://www.kennethkuhn.com/music/the_stars_and_stripes_forever.mp3 This is a performance of Sousa's famous march at a rational tempo instead of the insanely fast tempos often used. In this example there are a few areas where a shrillness happens when trumpets are loudly playing

what should be woodwind parts in extreme register. That is a characteristic that one has to accept at times.

http://www.kennethkuhn.com/music/sequoia.mp3 This is a performance of the well-loved and beautiful tone poem written by Homer C. LaGassey that is often performed by high school bands. The statistical orchestra works very well although the score had to be modified in some places with various octave translations to achieve the right sound.

http://www.kennethkuhn.com/music/the_universal_judgment.mp3 This is a performance of the famous tone poem by Camille De Nardis and transcribed for band by Antonio Cafarella. This piece had a number of challenges for my statistical orchestration. In one part a low level tympani roll is a must – something my system cannot do. I substituted a clarinet roll – and it at least works from a listening standpoint. There are several octave modifications to achieve the right sound.

http://www.kennethkuhn.com/music/egmont_overture.mp3 This performance of my favorite Beethoven overture is done at a more sane tempo rather than excessively fast. This is probably the best show piece of what my statistical orchestration can do. In a number of areas it could almost pass for a complete orchestration. Yet I had to significantly thin Beethoven's orchestration to fit the synthesizer.

http://www.kennethkuhn.com/music/tron_4.mp3 (*The Blossoms of Spring*, movement 4 (finale) of my epic tone poem, *The Revelation of Nature*). This is the ultimate example as it is the particular composition that the statistical orchestration was optimized for. This piece is a half hour long and demonstrates a wide variety of different tone colorations possible with the statistical orchestra. The file is about 30 megabytes and as such there is a wait before the music begins after you click on the link so be patient. In the near future I plan to do a complete orchestration of the work using Finale.