

Vocal simulation

This is an example of the use of the FOF generator to simulate a vocal sound. It is based on the generation of a sound with 5 formant regions, set in the variables *iform1-5*:

```
iform1 = 800           ; 5 formant regions
iform2 = 1150
iform3 = 2800
iform4 = 3500
iform5 = 4950
```

These formant regions have each 5 different amplitude levels, set by *iaf1-5*:

```
iaf1 = ampdb(0)       ; formant amplitudes
iaf2 = ampdb(-4)
iaf3 = ampdb(-20)
iaf4 = ampdb(-36)
iaf5 = ampdb(-60)
```

Each formant region has a different bandwidth, set in *ibw1-5*:

```
ibw1 = 50
ibw2 = 60
ibw3 = 170
ibw4 = 180
ibw5 = 200
```

These parameters are set for a particular vowel on a particular type of voice. In this case, the values refer to an 'a' sung by an alto voice.

In this instrument, we will make the sound gliss from one note to another, given by *ifun1* and *ifun2*. We will also make the *octaviation* parameter vary from *ioct1* to *ioct2*.

```
koct  linseg  ioct1, p3*.3, ioct1, p3*.4, ioct2, p3*.3, ioct2
kfun  expseg  ifun1, p3*.3, ifun1, p3*.4, ifun2, p3*.3, ifun2
```

For a successful vocal simulation is important to include some vibrato and a little frequency 'jitter'. The vibrato intensity (width) will also increase as we go towards the second note. The vibrato change will follow the change in the fundamental. Jitter is created by a random sig generator and the vibrato is a simple sine oscillator with an envelope:

```
ivib1 = .5*log(ifun1)   ; vibrato intensity
ivib2 = log(ifun2)

kvib  expseg  ivib1, p3*.3, ivib1, p3*.4, ivib2, p3*.3, ivib2

aj    randi  kvib, 125
kv    linen  kvib, .6, p3,.2
av    oscil  kv, 5.8, 1
```

The resulting sound from the 5 FOF generators is mixed, scaled and shaped by an exponential envelope (also sent to a global reverb):

```

kenv envlpx iamp, .05, isecs, .3, irshape, .9, .01 ; overall envelope
asum = al+a2+a3+a4+a5 ; mix all formant regions
garev = asum*iscal*kenv
out garev ; output

```

Here's the complete orchestra and score files:

```

; Formant synthesis example
; Victor lazzarini, 1998
sr = 44100
kr = 4410
ksmps = 10
nchnls = 1
garev init 0

instr 1

iol = 30 ; max overlaps
ifun1 = p5 ; fundamental 1
ifun2 = p6 ; fundamental 2
iamp = p4*.6 ; overall amp
isecs = p3 ; note duration in secs
irshape = 3 ; envlpx rise shape
isine = 1 ; sinewave
itxshape = 2 ; FOF granules tex shape

iform1 = 800 ; 5 formant regions
iform2 = 1150
iform3 = 2800
iform4 = 3500
iform5 = 4950

iaf1 = ampdb(0) ; formant amplitudes
iaf2 = ampdb(-4)
iaf3 = ampdb(-20)
iaf4 = ampdb(-36)
iaf5 = ampdb(-60)
iscal = 1/(iaf1+iaf2+iaf3+iaf4+iaf5) ; scale output

ibw1 = 50
ibw2 = 60
ibw3 = 170
ibw4 = 180
ibw5 = 200

ioct1 = p7 ; FOF parameters
ioct2 = p8 ; octavation
itx = p9 ; temps d'excitation (granule rise time!)
idur = .02 ; burst duration
iatt = .007 ; attenuation

ivib1 = .5*log(ifun1) ; vibrato intensity
ivib2 = log(ifun2)

; dynamic variation of FOF parameters
kocf linseg ioct1, p3*.3, ioct1, p3*.4, ioct2, p3*.3, ioct2
kfun expseg ifun1, p3*.3, ifun1, p3*.4, ifun2, p3*.3, ifun2
kvib expseg ivib1, p3*.3, ivib1, p3*.4, ivib2, p3*.3, ivib2

; jitter & vibr (p20)
aj randi kvib, 125
kv linen kvib, .6, p3,.2
av oscil kv, 5.8, 1

; fundamental + jitter + vibr
afun = kfun+av+aj

; fof generators
; amp fun fomfr oct ban tex idur iatt olap ifna ifnb dur ph mode

```

```

a1 fof iaf1, afun, iform1, koct, ibw1, itx, idur, iatt, iol, isine, itxshape, isecs, 0,1
a2 fof iaf2, afun, iform2, koct, ibw2, itx, idur, iatt, iol, isine, itxshape, isecs, 0,1
a3 fof iaf3, afun, iform3, koct, ibw3, itx, idur, iatt, iol, isine, itxshape, isecs, 0,1
a4 fof iaf4, afun, iform4, koct, ibw4, itx, idur, iatt, iol, isine, itxshape, isecs, 0,1
a5 fof iaf5, afun, iform5, koct, ibw5, itx, idur, iatt, iol, isine, itxshape, isecs, 0,1

kenv envlpx iamp, .05, isecs, .3, irshape, .9, .01 ; overall envelope
asum = a1+a2+a3+a4+a5 ; mix all formant regions
garev = asum*iscal*kenv
out garev ; output

endin

instr 10

; global reverb

ibal = p4
aout reverb garev, 0.9
out aout*ibal

endin

f1 0 4096 10 1 ; sine
f2 0 1024 19 .5 1 270 1 ; granule tex shape
f3 0 1025 05 0.01 256 .3 256 .8 512 1 ; envlpx rise shape

; amp fun1 fun2 oct1 oct2 tx
i1 .5 1 12000 330 330 0 0 .003
i1 + .5 16000 660 440 0 0 .003
i1 + 1.5 10000 400 400 0 0 .003
i1 + 1 15000 660 660 0 0 .003
i1 + .3 12000 660 600 0 0 .003
i1 + .3 10000 600 600 0 0 .003
i1 + .3 9000 510 510 0 0 .003
i1 + .3 8000 440 400 0 0 .003
i1 + 2 10000 345 310 0 0 .003
i1 + 2 13000 225 220 0 0 .003
i10 .5 11 .5
e

```