CLAIMS:

1. A method comprising:

generating an excitation signal from an audio signal, wherein in the audio signal comprises a plurality of frequency components;

extracting a feature vector from the audio signal, wherein the feature vector comprises at least one frequency domain component feature and at least one time domain component feature;

determining at least one spectral shape parameter from the feature vector, wherein the at least one spectral shape parameter corresponds to a sub band signal comprising frequency components which belong to a further plurality of frequency components; and

generating the sub band signal by filtering the excitation signal through a filter bank and weighting the filtered excitation signal with the at least one spectral shape parameter, wherein the spectral shape parameter is a sub band energy level value and the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.

2. The method as claimed in claim 1, wherein generating the excitation signal comprises:

generating a residual signal by filtering the audio signal with an inverse linear predictive filter;

filtering the residual signal with a post filter stage comprising an auto regressive moving average filter based on the linear predictive filter; and

generating the excitation signal by up sampling and spectrally folding the output from the post filter stage.

3. The method as claimed in claim 2, wherein the post filter stage further comprises a spectral tilt filter and a harmonic filter.

4. The method as claimed in claims 1 to 3, wherein the frequency components of the sub band signal are distributed according to a psychoacoustic scale comprising a plurality of overlapping bands, and the frequency characteristics of

the filter bank correspond to the distribution of frequency components of the sub band signal.

5. The method as claimed in claim 4, wherein the overlapping bands are distributed according to the mel scale, and wherein the sub band signal is masked using at least one of:

a triangular masking function; and

a trapezoidal masking function.

6. The method as claimed in claims 1 to 5, wherein determining at least one spectral shape parameter from the feature vector comprises:

using a neural network to determine the at least one spectral shape from the feature vector, wherein the feature vector extracted from the audio signal forms an input target vector to the neural network, and wherein the neural network is trained to provide a sub band spectral shape parameter for the input target vector.

~~7. The method as claimed in claims 1 to 6, wherein the spectral shape parameter is a sub-band energy level value.~~

~~8~~7. The method as claimed in claim ~~7~~1, wherein the spectral shape parameter is a sub band gain factor based on the sub band energy level value.

~~9. The method as claimed in claims 7 and 8, wherein the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.~~

~~10~~8. The method as claimed in claims 1 to ~~9~~7, wherein the at least one frequency domain component feature of the feature vector comprises at least one of the following:

a group of a plurality of energy levels of the audio signal, wherein each of the plurality energy levels corresponds to the energy of an overlapping band of the audio signal;

a value representing a centroid of the frequency domain spectrum of the audio signal; and

a value representing the degree of flatness of the frequency domain spectrum.

~~11~~9. The method as claimed in claims 1 to ~~10~~8, wherein the at least one time domain component feature of the feature vector comprises at least one of the following:

a gradient index based on the sum of the gradient at points in the audio signal which result in a change in direction of the waveform of the audio signal;

a ratio of the energy of a frame of the audio signal to the energy of a previous frame of the audio signal; and

a voice activity detector indicating whether a frame of the audio signal is classified as active or inactive.

~~12~~10. The method as claimed in any of claims 1 to ~~11~~9, further comprising;

combining the sub band signal with the audio signal to provide a bandwidth extended audio signal.

~~13~~11. An apparatus comprising at least one processor and at least one memory including computer code, the at least one memory and the computer code configured to with the at least one processor cause the apparatus to at least perform:

generating an excitation signal from an audio signal, wherein in the audio signal comprises a plurality of frequency components;

extracting a feature vector from the audio signal, wherein the feature vector comprises at least one frequency domain component feature and at least one time domain component feature;

determining at least one spectral shape parameter from the feature vector, wherein the at least one spectral shape parameter corresponds to a sub band signal comprising frequency components which belong to a further plurality of frequency components; and

generating the sub band signal by filtering the excitation signal through a filter bank and weighting the filtered excitation signal with the at least one spectral shape parameter, wherein the spectral shape parameter is a sub band energy level value and the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.

~~14~~12. The apparatus as claimed in claim ~~13~~11, wherein the at least one memory and the computer code configured to with the at least one processor to cause the apparatus to at least perform generating the excitation signal is further configured to perform:

generating a residual signal by filtering the audio signal with an inverse linear predictive filter;

filtering the residual signal with a post filter stage comprising an auto regressive moving average filter based on the linear predictive filter; and

generating the excitation signal by up sampling and spectrally folding the output from the post filter stage.

~~15~~13. The apparatus as claimed in claim ~~14~~12, wherein the post filter stage further comprises a spectral tilt filter and a harmonic filter.

~~16~~14. The apparatus as claimed in claims ~~13–~~11 to ~~15~~13, wherein the frequency components of the sub band signal are distributed according to a psychoacoustic scale comprising a plurality of overlapping bands, and the frequency characteristics of the filter bank correspond to the distribution of frequency components of the sub band signal.

~~17~~15. The apparatus as claimed in claim ~~16~~14, wherein the overlapping bands are distributed according to the mel scale, and wherein the sub band signal is masked using at least one of a triangular masking function; and a trapezoidal masking function.

~~18~~16. The apparatus as claimed in claims ~~13–~~11 to ~~17~~15, wherein the at least one memory and the computer code configured to with the at least one processor to

cause the apparatus to at least perform determining at least one spectral shape parameter from the feature vector is further configured to perform:

using a neural network to determine the at least one spectral shape from the feature vector, wherein the feature vector extracted from the audio signal forms an input target vector to the neural network, and wherein the neural network is trained to provide a sub band spectral shape parameter for the input target vector.

~~19. The apparatus as claimed in claims 13 to 18, wherein the spectral shape parameter is a sub band energy level value.~~

2017. The apparatus as claimed in claim ~~19~~11, wherein the spectral shape parameter is a sub band gain factor based on the sub band energy level value.

~~21. The apparatus as claimed in claims 19 and 20, wherein the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.~~

~~22~~18. The apparatus as claimed in claims ~~13~~ 11 to ~~21~~17, wherein the at least one frequency domain component feature of the feature vector comprises at least one of the following:

a group of a plurality of energy levels of the audio signal, wherein each of the plurality energy levels corresponds to the energy of an overlapping band of the audio signal;

a value representing a centroid of the frequency domain spectrum of the audio signal; and

a value representing the degree of flatness of the frequency domain spectrum.

~~23~~19. The apparatus as claimed in claims ~~13~~ 11 to ~~22~~18, wherein the at least one time domain component feature of the feature vector comprises at least one of the following:

a gradient index based on the sum of the gradient at points in the audio signal which result in a change in direction of the waveform of the audio signal;

a ratio of the energy of a frame of the audio signal to the energy of a previous frame of the audio signal; and

a voice activity detector indicating whether a frame of the audio signal is classified as active or inactive.

~~24~~20. The apparatus as claimed in any of claims ~~13~~ 11 to ~~23~~19, wherein the at least one memory and the computer code is further configured to perform;

combining the sub band signal with the audio signal to provide a bandwidth extended audio signal.

~~25~~21. A computer program product in which software code is stored in a computer readable medium, wherein said code realizes the following when being executed by a processor:

generating an excitation signal from an audio signal, wherein in the audio signal comprises a plurality of frequency components;

extracting a feature vector from the audio signal, wherein the feature vector comprises at least one frequency domain component feature and at least one time domain component feature;

determining at least one spectral shape parameter from the feature vector, wherein the at least one spectral shape parameter corresponds to a sub band signal comprising frequency components which belong to a further plurality of frequency components; and

generating the sub band signal by filtering the excitation signal through a filter bank and weighting the filtered excitation signal with the at least one spectral shape parameter, wherein the spectral shape parameter is a sub band energy level value and the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.

~~26~~22. The computer program product as claimed in claim ~~25~~21, wherein said code realizes generating the excitation signal when being executed by a processor the code further realizes:

generating a residual signal by filtering the audio signal with an inverse linear predictive filter;

filtering the residual signal with a post filter stage comprising an auto regressive moving average filter based on the linear predictive filter; and

generating the excitation signal by up sampling and spectrally folding the output from the post filter stage.

~~27~~23. The computer program product as claimed in claim ~~25~~22, wherein the post filter stage further comprises a spectral tilt filter and a harmonic filter.

~~28~~24. The computer program product as claimed in claims ~~25-~~21 to ~~27~~23, wherein the frequency components of the sub band signal are distributed according to a psychoacoustic scale comprising a plurality of overlapping bands, and the frequency characteristics of the filter bank correspond to the distribution of frequency components of the sub band signal.

~~29~~25. The computer program product as claimed in claim ~~28~~24, wherein the overlapping bands are distributed according to the mel scale, and wherein the sub band signal is masked using at least one of a triangular masking function; and a trapezoidal masking function.

~~30~~26. The computer program product claimed in claims ~~25-~~21 to ~~29~~25, wherein said code realizes determining at least one spectral shape parameter from the feature vector when being executed by a processor the code further realizes:

using a neural network to determine the at least one spectral shape from the feature vector, wherein the feature vector extracted from the audio signal forms an input target vector to the neural network, and wherein the neural network is trained to provide a sub band spectral shape parameter for the input target vector.

~~31. The computer program product as claimed in claims 25 to 30, wherein the spectral shape parameter is a sub band energy level value.~~

~~32~~27. The computer program product as claimed in claim ~~31~~21, wherein the spectral shape parameter is a sub band gain factor based on the sub band energy level value.

~~33. The computer program product as claimed in claims 31 and 32, wherein the sub band energy level value is attenuated when the power of the audio signal approaches an estimate of the level of noise in the audio signal.~~

~~34~~28. The computer program product as claimed in claims ~~25~~-21 to ~~33~~27, wherein the at least one frequency domain component feature of the feature vector comprises at least one of the following:

a group of a plurality of energy levels of the audio signal, wherein each of the plurality energy levels corresponds to the energy of an overlapping band of the audio signal;

a value representing a centroid of the frequency domain spectrum of the audio signal; and

a value representing the degree of flatness of the frequency domain spectrum.

~~35~~29. The computer program product as claimed in claims ~~25~~-21 to ~~34~~28, wherein the at least one time domain component feature of the feature vector comprises at least one of the following:

a gradient index based on the sum of the gradient at points in the audio signal which result in a change in direction of the waveform of the audio signal;

a ratio of the energy of a frame of the audio signal to the energy of a previous frame of the audio signal; and

a voice activity detector indicating whether a frame of the audio signal is classified as active or inactive.

~~36~~30. The computer program product as claimed in any of claims ~~25~~-21 to ~~35~~29, wherein the code further realizes;

combining the sub band signal with the audio signal to provide a bandwidth extended audio signal.

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