Speech enhancement cheat sheet

	Spectral subtraction	Subspace analysis	Wiener filtering	Kalman filtering
Main idea	Subtract noise spectral magnitude from observed signal	Remove noise subspace from observed signal	Filter signal to remove noise	Make statistical model in state space to separate speech and noise
Assumptions	SNR is high and speech and noise are uncorrelated Noise is additive and its magnitude spectrum is known	Speech has temporal structure Noise is additive, white and its energy is known	Speech and noise are uncorrelated Noise is additive and its autocorrelation is known	Speech can be modelled by an AR-process Noise is additive
Formulae	$\lvert\hat{X}(\omega)\rvert^2 = \lvert Y(\omega)\rvert^2 - \lvert X(\omega)\rvert^2$ $\measuredangle\hat{X}(\omega) = \measuredangle Y(\omega)$	$\hat{\mathbf{x}} = \mathbf{H}\mathbf{y}$ $\mathbf{x} = \mathbf{A}\mathbf{c}$	$\hat{x}_n = h_n * y_n$ $\mathbf{R}_y\mathbf{h} = \mathbf{r}_y - \mathbf{r}_v$	$\mathbf{x}_n = \mathbf{A}_{n,n-1}\mathbf{x}_{n-1} + \mathbf{u}w_n$ $\mathbf{y}_n = \mathbf{C}\mathbf{x}_n + \mathbf{v}_n$
Complexity	$O(N \log N)$	$O(N^3)$	$O(mN + N \log N)$	$O(m^2N)$
	(N is the frame or sample length and m the model order for respective model.)			
Notes	Simple yet reasonably effective, does not model phase properly	Non-heuristic interpretation, (sometimes) requires eigenanalysis	Simple yet powerful	Requires separate estimation of AR-model, complex programming

Table 1.1: Summary of speech enhancement methods presented in this book.