Periodic Lattices Near Isostaticity ANTON SOUSLOV, T.C. LUBENSKY, Dept. of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA 19104 — Lattices in $d$ dimensions with an average of $z = 2d$ contacts per site are at the verge of mechanical stability and are called isostatic. Common isostatic lattices include the two-dimensional square and Kagome lattices as well as the three-dimensional cubic lattice with nearest-neighbor sites connected by central-force springs of spring constant $k$ and randomly packed spheres at random close packing at what is called point $J$. We calculate the phonon response functions and spectra of nearly isostatic square, cubic, and Kagome lattices in which springs of spring constant $k'$ connect next-nearest-neighbor sites. These lattices exhibit highly anisotropic modes at $k' = 0$, among which are soft modes with one-dimensional dispersion in wavenumber, giving rise to a flat density of states as a function of frequency $\omega$. In the square lattice, these modes are shear acoustic phonons, whereas in the Kagome lattice, they are optical phonons. When $k' > 0$, the low-energy modes crossover from acoustic phonons of the appropriate lattice symmetry for $\omega < \omega^* \sim \sqrt{k'}$ to the soft isostatic-like modes for $\omega > \omega^*$, and the density of states crosses over from Debye-like to flat. Static phonon response functions exhibit correlation lengths $\xi \sim 1/\sqrt{k'}$. We discuss the relation of these results to those for jammed systems near point $J$.