Head-Tail Mode Instability Caused by Feedback, J. SCOTT BERG, Indiana University - In [1], Kikutani uses a two-particle model to demonstrate the existence of a "head-tail" instability caused by the presence of a feedback system. This paper demonstrates that this instability is a general feature of storage rings with a transverse low-frequency feedback system which damps the rigid (m = 0) modes but attempts to leave the head-tail (m = 1) modes unaffected. The growth rate is an effect of transverse mode coupling, but doesn't have a threshold. The growth rate increases quadratically (or even cubically under some assumptions) with current for small currents for a given feedback gain. For low gains, the effect is linear in the feedback gain. The formulation given is based on a Vlasov equation analysis, incorporating an impedance-like representation for the feedback system [2]. The associated growth rates for the $m = 1$ modes can be computed in the presence of an arbitrary impedance and feedback transfer function. In general, one needs to consider impedance together with the feedback system to get the correct effect; ignoring the impedance will give the incorrect result. The effects can be computed just as easily for a symmetric multibunch system as for a single-bunch system.

[1] Kikutani, Eiji, KEK Preprint 95-181.
[2] Berg, J. Scott and Ronald D. Ruth, Phys. Rev. E 52 pp. 2179--2182.