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Leveraged motion underwater sound piston transducers

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Flextensional transducers use leveraged shell motion to produce enhanced acoustic radiation from compact sources, which are often used in low frequency underwater sound applications. The most commonly used flextensional is the Class IV where an oval shell is driven along its major axis by a stack of piezoelectric ceramic elements. We present here a review of a new class of leveraged transducers in which the shell motion drives pistons attached to the shell at the location of maximum magnified motion. Because of the uniform motion of the pistons, greater source strength and radiation load is attained compared to the tapered motion of flextensional shells. The leveraged motion typically yields a motion magnification of approximately three and an impedance load magnification of approximately nine, resulting in reasonably low Q for a compact low frequency transducer. Various designs are presented and illustrated including one in which the piezoelectric drive simultaneously acts as a tail mass and one which operates in a high impedance velocity control mode under array conditions. Lumped models as well as FEA models and measured results are presented to illustrate the concept and performance of PZT and PMN-PT driven designs. [Work supported in part by ONR].