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We study equations from the area of peridynamics, which is an extension of elasticity. The governing equations form a system of nonlocal wave equations. Its governing operator is found to be a bounded, linear and self-adjoint operator on a Hilbert space. We study the well-posedness and stability of the associated initial value problem. We solve the initial value problem by applying the functional calculus of the governing operator. In addition, we give a series representation of the solution in terms of spherical Bessel functions. For the case of scalar valued functions, the governing operator turns out as functions of the Laplace operator. This result enables the comparison of peridynamic solutions to those of classical elasticity as well as the introduction of local boundary conditions into the nonlocal theory. The latter is studied in a companion paper. (Received December 12, 2014)