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Generation and propagation of shock wave trains in free liquid jets. CLAUDIU STAN, Rutgers Univeristy, Newark, GABRIEL BLAJ, SLAC National Accelerator Laboratory, PHILIP WILLMOT, Paul Scherrer Institut, MENGNING LIANG, JASON KOGLIN, ANDREW AQUILA, JOSEPH ROBINSON, RAYMOND SIERRA, SBASTIEN BOUTET, SLAC National Accelerator Laboratory — The shock structures that form in supersonic gas jets, discovered by Mach and Salcher 130 years ago, are a common sight in the exhaust of jet and rocket engines. The technology to produce sustained supersonic liquid jets out of a solid nozzle does not exist yet, but we discovered that similar shock trains can form in nearly stationary liquid jets ablated by femtosecond X-ray laser pulses. The shock trains were produced as an initial shock reflected multiple times at the surface of the jet. Using time-resolved optical imaging, we observed a range of nonlinear wave propagation phenomena either common to the gas jets (oblique shock reflections) or unique to liquids (negative pressures, cavitation). We estimated the positive and negative pressure excursions in the shock train using the velocities of shocks and of the expansion of cavitation bubbles. Although the shock amplitude decayed rapidly, trains with up to 6 shocks could be generated. For a brief period, the shock trains represent an extremely intense sound wave (~270 dB, re: 1 Pa) that is fundamentally limited to amplitudes just below those that would damage the wave propagating medium in a single oscillation cycle.

Claudiu Stan
Rutgers Univeristy, Newark

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