REMINISCENCES OF MIGUEL JUNGER

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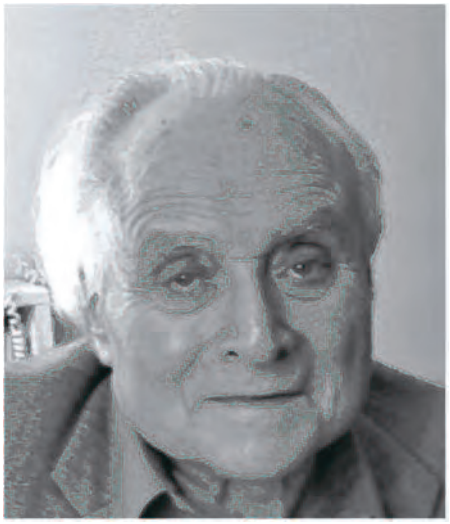
Miguel C. Junger was honored during the recent 165th Meeting of the Acoustical Society of America, held in Montreal, Canada on 2-7 June, 2013, jointly with the 21st International Congress on Acoustics and the 52nd Meeting of the Canadian Acoustical Association. The memorial session afforded colleagues, friends, and family the opportunity to reminisce and share sentiments of this remarkable man.

Invited papers were given by a number of his former colleagues, after his son Sebastian shared his recollections of "lessons learned" from his dad. In a moving talk, with his mother looking on with obvious pride, Sebastian remembered Miguel's love of history and the beauty of science and reason, as well as the importance he placed on family and friends and being true to your values. He fondly remembered at first confusing, but eventually invaluable, conversations with Miguel about fluid and structural dynamics while writing his first book, "The Perfect Storm."



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David Feit, in his talk "Miguel C. Junger: Legacy contribution to the field of structural acoustics", reviewed a number of Miguel's seminal contributions to structural acoustics, many of which appear in Miguel's classic text "Sound Structures and Their Interaction" (MIT Press, 1972, 1986), which was coauthored with David. He noted that in earlier texts on acoustics, including Lord Rayleigh's classic, The Theory of Sound, vibrations are treated in vacuo in the first volume and in the second volume the sound radiated by the vibrations is then considered. In contrast, here the influence of the acoustic medium on the vibration field is taken into account, earning the label "structural acoustics". David reviewed in some detail the early applications of the Sommerfeld-Watson transformation to analyze the asymptotic high frequency response of various acoustic and structural vibration problems occurring in separable geometries that admit analytic wave harmonic solutions. For example, the point driven fluid loaded, thin cylindrical shell of infinite extent. These series, which converge slowly at high frequencies, are transformed into a contour integral representation that is manipulated into fast converging series of residue terms. Moreover, these terms can individually be identified as propagating waves, revealing great insights into the physical nature of the solutions. The introduction of this technique was a major contribution to the structural acoustics community.

Joel Garrelick discussed the wonderfully insightful physical interpretations that typically accompanied Miguel's theoretical analyses. However, in his talk entitled, "Three curious results of radiation loading calculations", Joel focused on three cases where Miguel found providing such insights particularly challenging. These are:

1. At frequencies above coincidence, the power radiated by a point driven infinite thin plate exposed to a low impedance fluid is equal to the power radiated by that plate when submerged in a high impedance fluid.

2. At low frequencies, the entrained mass associated with a translating circular piston fully submerged in an acoustic medium is equal to that acting on the piston when it is baffled.

3. The low frequency admittance of a fluid loaded infinite thin plate driven by a point force exhibits a spring-like reactance, and yields a phase angle magnitude that is equal to that of the plate when driven by a line force. Questions appear to remain as to whether these outcomes are paradoxical, coincidental, or merely remain to be explained.

Tom Geers reflected on the extraordinarily broad range of Miguel's contributions to science and engineering. This included the field of bubble acoustics, which became of particular interest to Tom, and accordingly was the subject of his presentation on "Reduced models for violent bubble collapse". Following Miguel's love for the history of science, Tom traced the development of analytical bubble dynamic models over the last century or so, from early lumped parameter representations to finite difference solutions of the Euler equations, accounting for the internal gas and the occurrence of shock waves.

Rudolph Martinez, in his paper, "Poisson coupling in the in vacuo dynamics of an Infinite cylindrical shell", revisited the axisymmetric in vacuo dynamics of a thin cylindrical shell. Starting with the equations of motion as given in, "Sound, Structures and their Interaction", Rudolph described a perturbation analysis for the cross-coupling between in plane

and normal responses, with the square of Poisson's ratio, γ^2, as the small parameter. Somewhat surprisingly, Rudolph found that well below the shell's ring frequency, with a radial drive the zero'th order ratio of normal-to-surface motions is one of local reaction. It is not until the theory is carried out to $O(\gamma^2)$ that "wave propagation from axial compression begins to assert itself". After his formal presentation but quite applicable to his talk, Rudolph shared a wonderfully amusing anecdote that typified Miguel's humor, often self-deprecating. Apparently Miguel was able to argue, albeit without much success, that his appearance of weight gain was merely a consequence of Poisson coupling owing to his becoming shorter with age.

Ann Stokes, in her paper "Sound radiation by parallel coated plates separated by a fluid layer: here and then", fondly recalled Miguel's extraordinary facility to reduce this complex configuration, and in turn complex set of equations , to a manageable asymptotic mathematical model that was readily solved, while retaining the fundamental physics. In this particular case, with the primary interest being the far field (on-axis) radiated pressure from driven submerged vehicles, a lumped parameter model for the various individual layers generated valuable insights into the resonance enhancements predicted by the full analytical model. And, as described by Ann, such insights continue to be beneficial, when similar models are developed for evaluating noise control strategies for underwater pile driving activities. More generally, this modeling proficiency became one of Miguel's trademarks, and led to many of the canonical problems in structural-acoustics with which he is identified.

Klaus Kleinschmidt talked about an often overlooked aspect of Miguel's career, his work on acoustical products development, in his paper "Cooperating with Miguel on improvements of the acoustical product SOUNDBLOX". SOUNDBLOX is a slotted concrete block, designed to behave as a Helmholtz resonator, enhancing acoustic absorption in the vicinity of the cavity natural frequency. The cavity may be filled with absorptive material and a broader absorption spectrum was obtained with multiple cavities. As Klaus noted, the fact that the product, first introduced in the 1950's is still on the market, reflects well on their collaboration.

Miguel Junger was born in Dresden, Germany on 23 January 1923. His father was a journalist for the French and German press, and his family lived in Germany, Spain and France, where he received his high school education at the French Lycee. Miguel Arrived in the USA with his parents in 1941. He entered the Masssachusetts Insittute of Technology, earning the B.S. degree in 1944 and the M.S. degree two years later. He subsequently went to Barry Controls where he was mentored by C.E. Crede. His work with Crede on the shock resistance of shipboard mechanical equipment was published in book form by the Navy Bureau of Ships. Here, it is interesting to note that it was conversations with Crede that led Miguel to pursue his doctoral studies, and Miguel was honored by the ASA in 1987 with the Trent-Crede Medal, one of the men for whom the medal is named.

Miguel received his Sc.D. from Harvard University in 1951 as a Gordon McKay Fellow and worked under F.V. Hunt at the Harvard University Acoustics Research Laboratory. It was here that Miguel met fellow student Preston Smith, Jr. In 1955 Miguel and Preston became founding partners of Cambridge Acoustical Associates, Inc. a small consulting firm in Cambridge, MA. While Preston left CAA and joined Bolt, Beranek and Newman in 1959, Miguel worked at CAA as President, and as Chief Scientist until his retirement in 1997.

Miguel's extraordinarily productive career has resulted in almost one hundred technical papers, many in the JASA, chapters in books of collected works, and two published books, one in French, the other in English. The first book, coauthored with M. Perulli and entitled "Elements d'Acoustique Physique", grew out of a collaboration while Miguel lectured at the Universite' de Technologie de Compiegne. The second, "Sound, Structures and their Interaction", coauthored with David Feit, first published in 1972, and reissued as a second edition in 1986 and then reprinted by the ASA in 1993. It is widely acclaimed and internationally recognized as one of the classic structural-acoustic texts.

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Complementing his scholarly contributions, Miguel has played an equally important teaching role as lecturer and mentor. In addition to his stint at the Universite' de Technologie de Compiegne, he has lectured at MIT and Pennsylvania State University. Additionally, the work of his associates at CAA and "graduates" of the firm who have progressed elsewhere, including those who join us in this tribute today, provide a continuing testimony to his role as educator.

Miguel has been honored by his peers throughout his career. For examples, he has been elected to fellowship in both the Acoustical Society of America and the American Society of Mechanical Engineers, chosen to present a distinguished Lecture at Noise-Con 87, and selected to receive the Per Bruel Gold Medal by ASME, and, as mentioned above, earned the ASA's Trent-Crede Medal in 1986. In closing, both for his scientific brilliance and personal warmth and integrity, Miguel C. Junger, "the father of structural acoustic", will be profoundly missed.

Miguel Junger and son Sebastian

Portions of this article were excerpted from the Citation to Miguel C, Junger in connection with his being awarded the Trent-Crede Medal by the ASA.