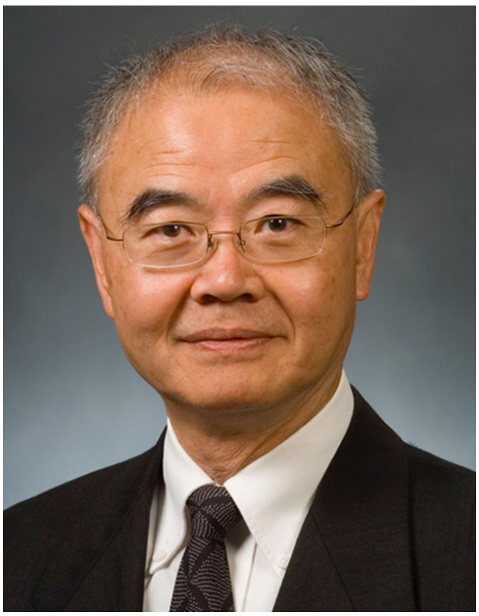
Shock Waves (2019) 29:599–600
https://doi.org/10.1007/s00193-019-00909-z

OBITUARY

Memories of Meng-Sing Liou (1947–2017)

B. van Leer[1]



On September 29, 2017, Dr. Meng-Sing Liou, Senior Technologist at NASA Glenn Research Center and Fellow of the American Institute of Aeronautics and Astronautics, passed away after a four-year struggle with cancer. He was known among his colleagues as an imaginative and broad researcher, and also as a gentle and modest soul, who yet did not shrink from assuming leadership when called upon. He left us a wide range of contributions to the field of CFD.

I last saw Meng in 2012, the year of my retirement, when he and his wife unexpectedly visited the Department of Aerospace Engineering at the University of Michigan, the very place where we first met, 27 years earlier, when I was interviewed for a full professorship in the department. The position came with the assignment to establish research and teaching in computational fluid dynamics. At that time, Meng, who was a visiting associate professor, had already taught CFD in Taiwan and now was teaching a two-semester CFD course in the department, the first one to do so at UMich. He knew my work well and very much wanted the Department to hire me. And so it happened.

Meng had obtained his PhD at UMich in 1977 and had come back after some time in industry and a brief stint (1982–1984) as chair of the Department of Aeronautics and Astronautics at National Cheng Kung University, Taiwan, a position that at the time was not a good fit to his interests. He was a researcher at heart and not ready to become an administrator. A similar episode occurred early in Meng's career at NASA Glenn Research Center, where in 1988–1990 he served as head of the Computational Fluid Dynamics Branch.

By the time I arrived at my new workplace, Meng had joined NASA Lewis (now Glenn) Research Center (GRC). Soon thereafter he engaged me about establishing collaborations with GRC researchers via the new Institute for Computational Propulsion (ICOMP), and this led to many visits by me through the years, lastly in 2006. During such visits, I worked chiefly with Meng, Bill Coirier, and Hung Huynh.

What did Meng and I work on? In the late 1980s, there was still a lot of interest in improving numerical recipes for computing the fluxes of conserved flow quantities at the interface between two computational fluid cells. In particular, we were searching for a formula with the simplicity of Flux-Vector Splitting (FVS) and the low diffusion error of the more complex Flux-Difference Splitting (FDS). Such low diffusion was an absolute necessity for preserving boundary layer structure in viscous-flow calculations. In the winters of 1989 and 1990, I had the students in my advanced CFD class try out a variety of numerical flux formulas, including some FVS-based ones that had recently appeared in the literature. One of the students in the Winter 1990 class was Chris Steffen, who, with a Master's degree, joined GRC the next summer, working under Meng's guidance. His recent class experience made him ideally suited to assist Meng in the search for the ultimate flux formula, and from their collaboration soon emerged a true gem: the Advection Upstream Splitting Method or AUSM. Meng's clever idea was to replace splitting the full mass flux by splitting the Mach number of

✉ B. van Leer
bram@umich.edu

[1] Department of Aerospace Engineering, The University of Michigan, Ann Arbor, MI, USA

the flow. With the latter, an effective interface Mach number is computed, defining the upwind direction at the interface. Now the fluxes of all advected quantities are computed with their upwind value; only the pressure terms are split as usual.

AUSM was presented at the 10th AIAA CFD conference in Honolulu, 1991, albeit only in a poster session. (I felt embarrassed about that, as my own conference paper co-authored by Bill Coirier, about low-diffusion, pure FVS, a paper with only negative results, had been given a podium.)

Nevertheless, AUSM soon started on a triumphant march through all possible flow disciplines, ranging from aerodynamics, chemically reacting flow, multiphase flow, and magnetohydrodynamics, to atmospheric and galactic flows, over speed regimes from almost incompressible to hypersonic. Meng made a number of modifications and improvements to the original formula to suit special applications, for instance, the version for low-speed flow that uses an artificially lowered speed of sound. Regarding the number of citations, the papers on AUSM from 1993 [1] and 1996 [2] in the Journal of Computational Physics are Meng's most visible contributions to the CFD literature, with more than 2000 citations together.

Meng's research interests were much broader than mine. With him I worked on flux formulas for reacting flows and on implicit upwind operators. While I spent many subsequent years on convergence acceleration, Discontinuous Galerkin methods, and methods for extended hydrodynamics, Meng diversified into grid generation, turbulence modeling, multidisciplinary design, analysis and optimization, multiphase flow, and nonlinear flow modeling. Let me highlight two of these efforts.

To accurately treat viscous regions over complex geometries by using quality structured meshes, Meng developed a fast grid method, known as DRAGON (Direct Replacement of Arbitrary Grid-Overlapping with Non-structured grid); it results in an approach combining strengths of structured and unstructured grid methods, while minimizing their respective shortcomings. Furthermore, to bring advanced computational predictive capabilities to real-world engineering design, Meng had been developing high-fidelity, multidisciplinary and multi-objective design optimization capabilities using genetic algorithms and adjoint methods. This effort has resulted in significant improvements and new shapes that would seem unprecedented by conventional approaches. Meng was leading an in-house NASA project to develop multidisciplinary design, analysis, and optimization capabilities for aerospace applications, with relevance to NASA's current Fundamental Aeronautics Program, for advanced supersonic and subsonic vehicles, especially the hybrid wing body concepts with integrated boundary layer ingestion propulsion systems. This type of leadership suited him well.

Returning to that day in my office in the spring of 2012, I found that Meng looked and sounded frail. "Has he aged so quickly?" I thought, "He is years younger than I am." It did not occur to me that Meng was ill. We never spoke again.

With the death of Meng-Sing Liou, our research community has lost an inspired, dedicated researcher and a much appreciated, sympathetic colleague.

References

1. Liou, M.-S., Steffen, C.: A new flux splitting scheme. J. Comput. Phys. **107**, 23–39 (1993). https://doi.org/10.1006/jcph.1993.1122
2. Liou, M.-S.: A sequel to AUSM: AUSM$^+$. J. Comput. Phys. **129**, 364–382 (1996). https://doi.org/10.1006/jcph.1996.0256