

1155-68-5

**Josh Alman\*** ([jalman@mit.edu](mailto:jalman@mit.edu)), 32 Vassar Street, 32G-634, Cambridge, MA 02139. *Limits on the Universal Method for Matrix Multiplication.*

In this work, we prove limitations on the known methods for designing matrix multiplication algorithms. Alman and Vassilevska Williams recently defined the *Universal Method*, which substantially generalizes all the known approaches including Strassen’s Laser Method and Cohn and Umans’ Group Theoretic Method. We prove concrete lower bounds on the algorithms one can design by applying the Universal Method to many different tensors. Our proofs use new tools for upper bounding the *asymptotic slice rank* of a wide range of tensors. Our main result is that the Universal Method applied to any Coppersmith-Winograd tensor  $CW_q$  cannot yield a bound on  $\omega$ , the exponent of matrix multiplication, better than 2.16805. By comparison, it was previously only known that the weaker ‘Galactic Method’ applied to  $CW_q$  could not achieve an exponent of 2. (Received August 03, 2019)