1011-68-219 **Eric Allender*** (`allender@cs.rutgers.edu`), Department of Computer Science, Rutgers University, 110 Frelinghuysen Road, Piscataway, NJ 08854, and **Peter Buergisser**, **Johan Kjeldgaard-Pedersen** and **Peter Bro Miltersen**. *On the Complexity of Numerical Analysis.* Preliminary report.

We consider two different approaches to studying problems in numerical analysis:

- The Blum-Shub-Smale model incorporates $\mathbb{R}$ directly into computation, providing a way to classify the complexity of continuous functions and sets of reals. This gives the class $\mathrm{P}_{\mathbb{R}}$. An important subclass (denoted $\mathrm{P}^0_{\mathbb{R}}$) arises when machines are provided only with algebraic real numbers.
- We define a problem entirely within the realm of discrete computation (the "generic task of numerical analysis") to study the computational complexity confronting the designers of numerically stable algorithms.

We show that both of these approaches hinge on the complexity of the following problem, which we call PosSLP:

Given a division-free straight-line program producing an integer N, decide whether $N > 0$.

We show $\mathrm{P}^{\mathrm{PosSLP}}$ = the Boolean part of $\mathrm{P}^0_{\mathbb{R}}$, and PosSLP is poly-time equivalent to the "generic task of numerical analysis".

We show that PosSLP lies in the counting hierarchy (CH). As a consequence, we show that the Euclidean Traveling Salesman Problem lies in CH – the previous best upper bound for this problem (in terms of classical complexity classes) being PSPACE. (Received August 28, 2005)