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Games for PDEs with eigenvalues of the Hessian

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For a function $u : \Omega \subset \mathbb{R}^N \mapsto \mathbb{R}$, we consider the Hessian, D^2u, and its ordered eigenvalues

$$\lambda_1(D^2u) \leq ... \leq \lambda_N(D^2u).$$

Here our main concern is the Dirichlet problems for the equations:

$$P_k^+(D^2u) := \sum_{i=N-k+1}^{N} \lambda_i(D^2u) = 0, \tag{0.1}$$

(note that P_k^+ is just the sum of the k largest eigenvalues)

$$P_k^-(D^2u) := \sum_{i=1}^{k} \lambda_i(D^2u) = 0, \tag{0.2}$$

(P_k^- is the sum of the k smallest eigenvalues) and, more generally, any sum of k different eigenvalues

$$P_{i_1,\dots,i_k}(D^2u) := \sum_{i_1,\dots,i_k} \lambda_{i_j}(D^2u) = 0. \tag{0.3}$$

These operators appear in connection with geometry but our goal is to provide a probabilistic interpretation.

We will describe games whose values approximate viscosity solutions to these equations in the same spirit as the random walk can be used to approximate harmonic functions.

Joint work with P. Blanc (U. Buenos Aires, Argentina).

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