Parallel algorithm to determine the solutions of the bimatrix informational extended games

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Consider the bimatrix game $\Gamma = \langle I, J, A, B\rangle$ in complete and $(1 \leftrightarrows 2)-$ perfect information over the sets of pure strategies. To solve games of this type we propose the following methodology [1]. The first, for *game in complete and perfect information over the sets of pure strategies* Γ we will build the *game in perfect information over the sets of informational extended strategies* $Game\,(1 \leftrightarrows 2)$. Second, for the game $Game\,(1 \leftrightarrows 2)$ we will build the *incomplete and imperfect information game generated by the informational extended strategies* $\widetilde{\Gamma} = \left\langle \{1,2\}, I, J, \left\{ AB(\mathbf{i},\mathbf{j}) = \left\| \left(a_{i_j j_i}, b_{i_j j_i}\right) \right\|_{i\in I}^{j\in J} \right\}_{\mathbf{i}\in\mathbf{I}}^{\mathbf{j}\in\mathbf{J}} \right\rangle$. Third, for the game $\widetilde{\Gamma}$ we will generate the associated *Bayesian game in the non informational extended strategies*

$\Gamma_{Bayes} = \langle \{1,2\}, \{\Delta_1, \Delta_2\}, \mathbf{L}, \mathbf{C}, \mathbf{A}, \mathbf{B} \rangle$. Finaly any fixed $\alpha \in \Delta_1$ and $\beta \in \Delta_2$ we will determine the solutions of the following sub games $sub\Gamma_{Bayes} = \langle \{1,2\}, \mathbf{L}(\alpha), \mathbf{C}(\beta), \mathbf{A}(\alpha), \mathbf{B}(\beta) \rangle$ of the game Γ_{Bayes}. Using the MPI-OpenMP programming model and ScaLAPACK -BLACS packages we have elaborated the parallel algorithm to find the all equilibrium profiles $(\mathbf{l}^*, \mathbf{c}^*)$ in the game Γ_{Bayes}. We can demonstrate the following theorem that estimate the run time performance and communication complexity of the parallel algorithm.

Theorem 1. *The run time complexity of the parallel algorithm is*

$$T_{comput} = \sum_{k=2}^{7} T_p^k = O(\max(n,m)) + O\left(\max(\varkappa_1, \varkappa_2)\right) +$$
$$+ O\left(\max\left(|\mathcal{I}|, |\mathcal{J}|\right)\right) + O\left(\max\left(\left|\widehat{\mathcal{I}}\right|, \left|\widehat{\mathcal{J}}\right|, |grBr_1| \cdot |grBr_2|\right)\right)$$

and communication complexity is

$$T_{comm} = O\left(t_s + \left[\max\left(|\mathcal{I}| \times |\mathcal{J}|, m \times n\right)\right] * t_b + t_h\right).$$

Bibliography

[1] Boris Hâncu, Anatolie Gladei. *Parallel algorithm to find Bayes-Nash solution to the bimatrix informational extended game.* Computer Science Journal of Moldova (CSJM). V. 26, n.1(76), 2018. Pages 39-58.

Synthesis of the minimum variance control law for the linear time variant processes

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Above the linear process can act the disturbance signals, so kind of processes can be described by the parametrical models, where the most used take part from the ARMAX class (Auto-Regressive Moving Average with eXogenous control). The general model of the class is the ARMAX model $[na, nb, bc, nk]$, which in fact represents that the output signal is obtained as a result of the superposition between a useful signal obtained by filtering the input signal and a parasitic signal obtained by filtering the white noise :

$$y(k) = \frac{B(q^{-1})}{A(q^{-1})} u(k) + \frac{C(q^{-1})}{A(q^{-1})} e(k) = y^u(k) + y^e(k).$$

where $y(k)$ is the output of the noisy system, $u(k)$ - control signal, $e(k)$ is a sequence of independent normal variables with zero mean value and variance one (white noise) and the polynomials $A(q^-1), B(q^-1), C(q^-1)$ are

$$A(q^{-1}) = 1 + a_1 q^{-1} + ... + a_{na} q^{-na},$$
$$B(q^{-1}) = b_1 q^{-1} + ... + b_{nb} q^{-nb},$$