J. of Ramanujan Society of Mathematics and Mathematical Sciences
Vol. 9, No. 2 (2022), pp. 109-130

ISSN (Online): 2582-5461

ISSN (Print): 2319-1023

THE EULER METHOD IN THE BLOW-UP NUMERICAL SOLUTIONS FOR A REACTION-DIFFUSION PROBLEMS WITH BOUNDARY CONDITIONS

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(**Received:** *Mar. 19, 2022* **Accepted:** *Apr. 15, 2022* **Published:** *Jun. 30, 2022)*

Abstract: This paper concerns the study of the numerical approximation for the following initial-boundary value problem

$$\begin{cases} u_t(x,t) - u_{xx}(x,t) = \gamma e^{u(a,t)}, \quad x \in (0,1), \quad t \in (0,T), \\ u(0,t) = 0, \quad u_x(1,t) = 0, \quad t \in (0,T), \\ u(x,0) = u_0(x) \geq 0, \quad x \in [0,1], \end{cases}$$

where $u_0 \in C^1([0,1])$, $u_0(0) = 0$, $u_0'(1) = 0$. $a \in (0,1)$, γ is a positif parameter. We find some conditions under which the solution of a semidiscrete form of the above problem blows up in a finite time and estimate its semidiscrete blow-up time. We study the asymptotic behavior of a semi-discrete numerical approximation. We also prove the convergence of the semidiscrete blow-up time to the theoretical one. A similar study has been also undertaken for a discrete form of the above problem. Finally, we give some numerical results to illustrate our analysis.Also obtaining results on the convergence of the numerical blow-up times to the theoretical limit