

# Journal of Machine Learning

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## **RNN-attention based deep learning for solving inverse boundary problems in nonlinear Marshak waves**

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### **Summary for general readers:**

Inertial confinement fusion (ICF) refers to the fusion energy released when a small amount of hot nuclear fuel is ignited by high-power substances to make it reach the ignition conditions under inertial confinement. The ICF implosion is characterized by the equations of radiation hydrodynamics, which are mainly composed of equations describing fluid motion, electron heat conduction, ion heat conduction, photon transport, nuclear reaction and charged particle transport.

In practical applications, the focus of research in inertial confinement fusion (ICF) is on determining the appropriate boundary conditions that will achieve the desired temperature control of both material and radiation during the fusion process. In mathematics, this is a typical inverse problem, and traditional numerical methods require multiple solutions of differential equations, which is a highly costly task. Moreover, due to the physical conditions of ICF, acquiring the raw data can be extremely expensive.

This article proposes a method of using RADL neural network as a surrogate model to obtain approximate solutions to inverse problems, which efficiently solves the problems of high computational cost and difficult data acquisition in traditional numerical methods.