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Expository Articulation of Non-Steady State Non-Linear Solutions of Concentration Utilizing Homogony Perturbation Method

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Abstract: This paper plans to present a scientific system and we consider the numerical demonstrating of the arrangement of the non-relentless state and non-straight differential conditions specifically the Homotopy perturbation method(HPM).From the figuring, perspective examination demonstrates that a Homotopy perturbation strategy is an effective instrument to tackle non-linear differential condition and simple to approach. The arrangement acquires from this approach is great when contrasted with other standard numerical techniques.

Keywords: Homotopy perturbation method, Non-linear differential equations

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I. INTRODUCTION

We diagram the fundamental thought of Homotopy Perturbation strategy. This technique has wiped out the confinement of the customary Perturbation strategies. Then again, it can take full preferred standpoint of the conventional bother methods, so there has been an impressive arrangement of research in applying Homotopy system for unraveling different unequivocally non-linear conditions. To clarify this strategy, let us think about the accompanying condition

A (u)-f(r) =0, $r \in \Omega$ (1.1)

With the boundary condition of

$B\left(u, \frac{\partial u}{\partial x}\right) = 0 ; r \in \Gamma$ (1.2)

Where A, B, f(r) and Γ signifies a general differential administrator, a limit administrator, a known explanatory capacity and the limit of the area Ω individually. As a rule the administrator A can be separated into a straight part L and a non-direct part N

Equation (1.1) can therefore be written as

L(u)+N(u)-f(r)=0 (1.3)

By the homotopy perturbation technique,

We construct a homotopy $v(r,p): \Omega \times [0,1] \to R$ which satisfies

$H(v,p) = (1-p)[L(v) - L(u_0)] + p[A(v) - f(r)] = 0 \quad , \quad p \in [0,1], r \in \Omega$ (1.4)

(or) $H(v,p) = L(v) - L(u_0) + pL(u_0) + p[N(v) - f(r)] = 0$ (1.5)

Where $p \in [0,1]$ an inserting parameter and u_0 is an underlying guess of Condition (1.1), which fulfills the limit condition. Clearly, from Condition (1.4) and (1.5), we will have

H (v, 0) =L (v)-L (u_0) =0 (1.6)

H (v, 1) =A (v)-f(r) =0 (1.7)

At the point when p=0 Condition (1.4) or Condition (1.5) turns into a linear condition; when p=1 it turns into a non-linear condition. So the changing procedure of p from 0 to 1 is only that of L(v)- L(u_0)=0 to A(v)- f(r)=0.we would first be able to utilize the inserting parameter p as a little parameter and accept that the arrangement of condition (1.4) and (1.5) can be composed as a power arrangement in p

$v = v_0 + pv_1 + p^2 v_2 + \cdots$ (1.8)

Putting p=1, results in the approximate solution of equation (1.1)

$u = \lim_{p\to 1} v = v_0 + v_1 + v_2 + \cdots$ (1.9)

The combination of the perturbation method and the Homotopy method is called the Homotopy perturbation method

MATHEMATICAL FORMULATION OF THE PROBLEM

We consider the following non linear ordinary differential equation [1]:

$$u''(x) + u^2(x) = 0 \tag{1.10}$$

The boundary conditions are

$$u(0) = a \quad u'(1) = 0 \tag{1.11}$$

There exists no small parameter in the condition, in this manner, the customary perturbation methods can't be connected specifically, As of late significant consideration has been straightforwardly towards systematic answers for non-linear condition without small parameters numerous new procedures have showed up in the writing, for instance, the Homotopy bother technique the vibrational emphasis method and the vitality adjust strategy.

EXPOSITORY ARRANGEMENT OF THE FOCUS UTILIZING HOMOTOPY PERTURBATION METHOD

Non-Linear marvels assume a critical part in connected science and science. Development of specific correct answer for the above condition remains an essential issue. Finding careful arrangements that have a physical, synthetic or organic elucidation is of crucial significance. This model-based enduring state arrangement of dispersion conditions containing a non-direct response term identified with Michaelis-Menten Energy of the enzymatic responses. It isn't conceivable to tackle these conditions utilizing standard systematic strategies. In the past numerous creators predominantly had focused on examine arrangement of non - straight conditions by utilizing different strategies, for example, Backlund transformation[4].Darboux transformation,[10].Inverse dispersing method[5].Bilinear method,[5].the tanh method,[9].variational emphasis method,[8].and Homotopy bother method,[8-9] .etc.The Homotopy annoyance technique has been widely worked out finished various years by various authors.The Homotopy perturbation method(HPM) was first proposed to be He [8-9] and was effectively connected to self-sufficient normal differential conditions to non-direct polycrystalline solids and alternate fields. As of late Meena and Rajendran[3], actualized homotopy perturbation strategy to give the inexact arrangement of non-linear response dispersion conditions containing a non-direct term identified with Michaelis-Menten energy of the enzymatic reaction.Eswari it al in series[1] fathomed the coupled non-direct dissemination condition diagnostically for the microdisk and microcylinder compound terminal when an item shape an immobilized catalyst responds with the cathode. By settling the above condition (1.10) utilizing Homotopy bother method

$$u(x) = \frac{a^2}{2}x^4 - a^3x^3 - \frac{a^2}{2}x^2 + a^3x + a^2x + a \tag{1.12}$$

At that point condition (1.12) fulfills the boundary condition (1.11).This condition speaks to the new estimate investigative articulation of the fixation u(x) for every single conceivable estimation of the parameter a. It is contrasted and numerical outcomes and gives the attractive assent ion.

II. DISCUSSION

The concentration of u(x) utilizing condition (1.12) is spoken to in Figures (1.1-1.5).From these figures, it is construed that the estimations of focus increments when the estimation of an expansion the fixation is gradually expanding and unexpectedly achieves the steady esteem when $x \geq 0.5$ for all estimations of a. In these figures, our diagnostic outcomes are contrasted and reenactment comes about for all estimations of the parameter a.It give the great assention

MATHEMATICAL FORMULATION OF NON STEADY STATE PROBLEM AND ANALYSIS

The underlying limit esteem issue which must be understood for the instance of non relentless state can be composed in dimensionless shape as takes after

$$\frac{du}{dt} = u'' + u^2 \tag{1.13}$$

The condition must comply with the accompanying initial boundary condition progress toward becoming

$$t=0,\ u=1 \tag{1.14}$$

$$u(0) = a, u'(1) = 0 \tag{1.15}$$

Here there is no thorough systematic or numerical answer for the above issue. Numerical recreation of concentaration can be assessed utilizing MATLAB programming (Appendix 2.B)

DISCUSSION OF NON STEADY STATE PROBLEM

The standardized numerical reproduction of three-dimensional fixations u(x) is appeared in Figure 1.6, Figure 1.7, Figure 1.8, figure 1.9 and Figure 1.10.As appeared in Figures 1.6 to 1.10 gives the computed reaction bend at various estimations of the parameters an in our outline. The time-subordinate fixation u(x) utilizing condition (1.13) is spoken to in Figures (1.6-1.10).The focus is gradually expanding when the parameter a is expanded. The slant of the bend increments drastically and the focus is indistinguishable range when the parameters a is high.

III. CONCLUSIONS

In this paper, the time-free non-linear response/ diffusion condition has been detailed and comprehended diagnostically utilizing Homotopy perturbation technique. We have exhibited a basic and shut type of a diagnostic articulation comparing to the focus u(x) for all estimations of a. Besides based on the result of this work. It is conceivable to compute the inexact measure of the fixation. This essential consequence of this work is a first rough estimation of focus for all estimations of a. It gives the great understanding inside the numerical outcome. The augmentation of the strategy to two dimensional and three – dimensional geometrics with different complex boundary conditions seen conceivable

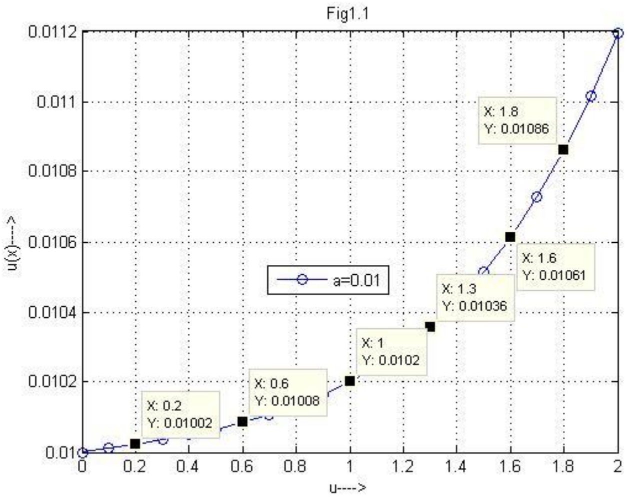

Fig 1.1 comparison of the normalized concentration of u(x) with simulation result. The key to the graph (--) represents the equation (1.12) and (xxx) represent the simulation result. The profile was computed using Equation (1.12) for the value of a=0.01.

Fig 1.2

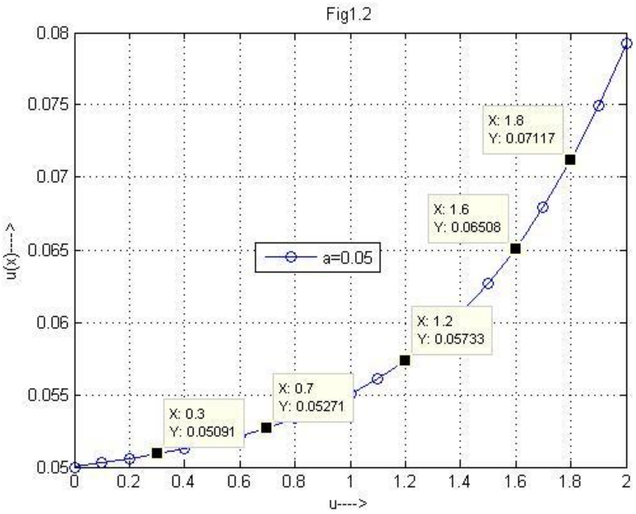

Fig 1.2 comparison of the normalized concentration of u(x) with simulation result. The key to the graph (--) represents the equation (1.12) and (xxx) represent the simulation result. The profile was computed using Equation (1.12) for the value of a=0.05.

Fig 1.3

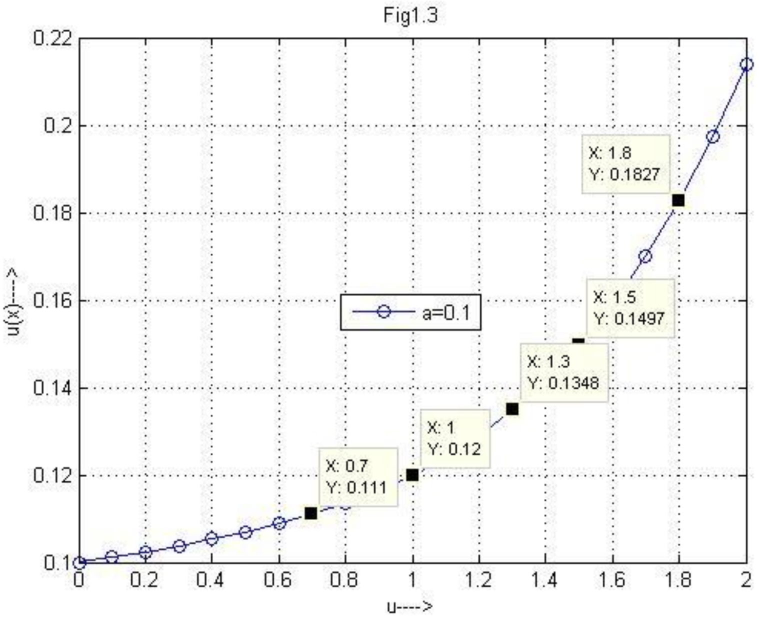

Fig 1.3 comparison of the normalized concentration of u(x) with simulation result. The key to the graph (--) represents the equation (1.12) and (xxx) represent the simulation result. The profile was computed using Equation (1.12) for the value of a=0.1.

Fig 1.4

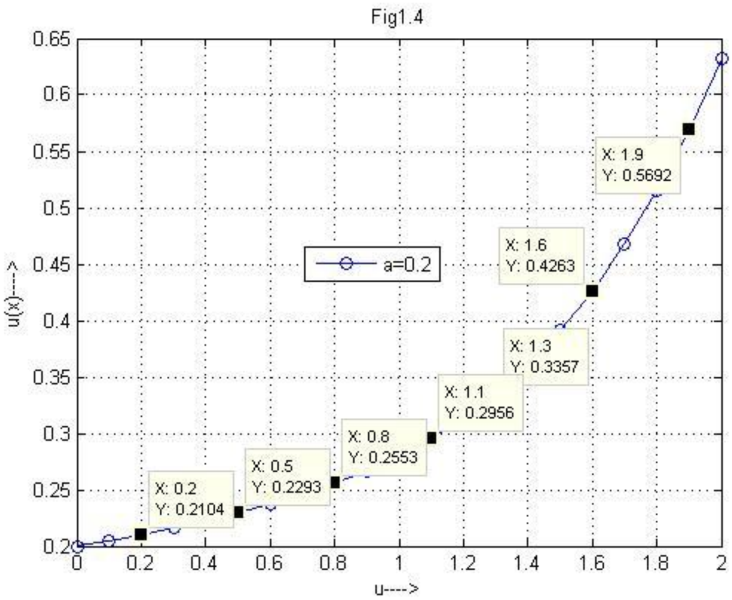

Fig 1.4 comparison of the normalized concentration of u(x) with simulation result. The key to the graph (--) represents the equation (1.12) and (xxx) represent the simulation result. The profile was computed using Equation (1.12) for the value of a=0.2

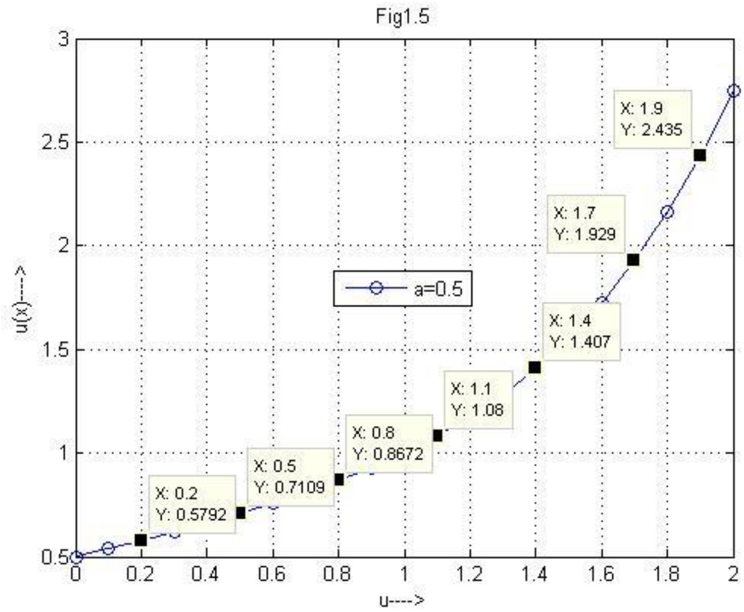

Fig 1.5 comparisons of the normalized concentration of u(x) with simulation result. The key to the graph (--) represents the equation (1.12) and (xxx) represent the simulation result. The profile was computed using Equation (1.12) for the value of a=0.5.

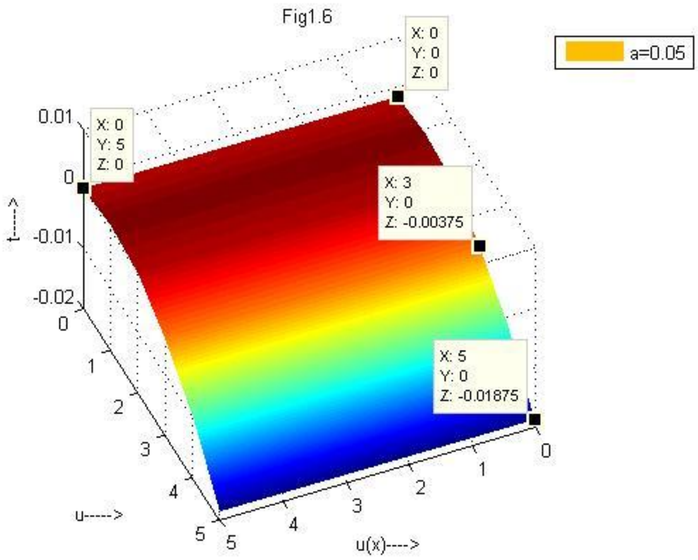

Fig1.6 The normalized numerical simulation of three dimensional concentration u(x,t) is plotted. The plot was constructed using equation 1.12 for a=0.05

Fig 1.7

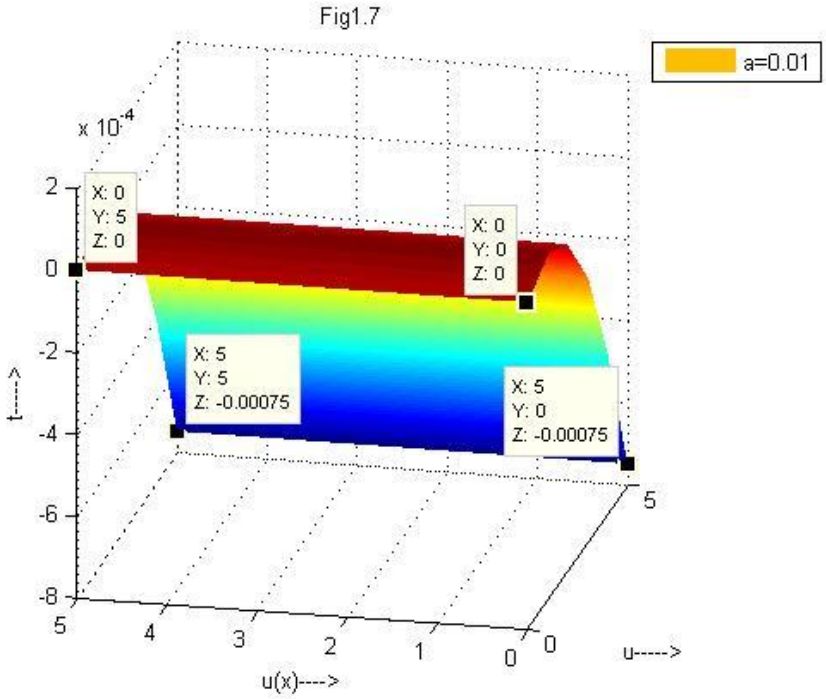

Fig1.7 The normalized numerical simulation of three-dimensional concentration u(x,t) is plotted. The plot was constructed using equation 1.12 for a=0.2

Fig 1.8

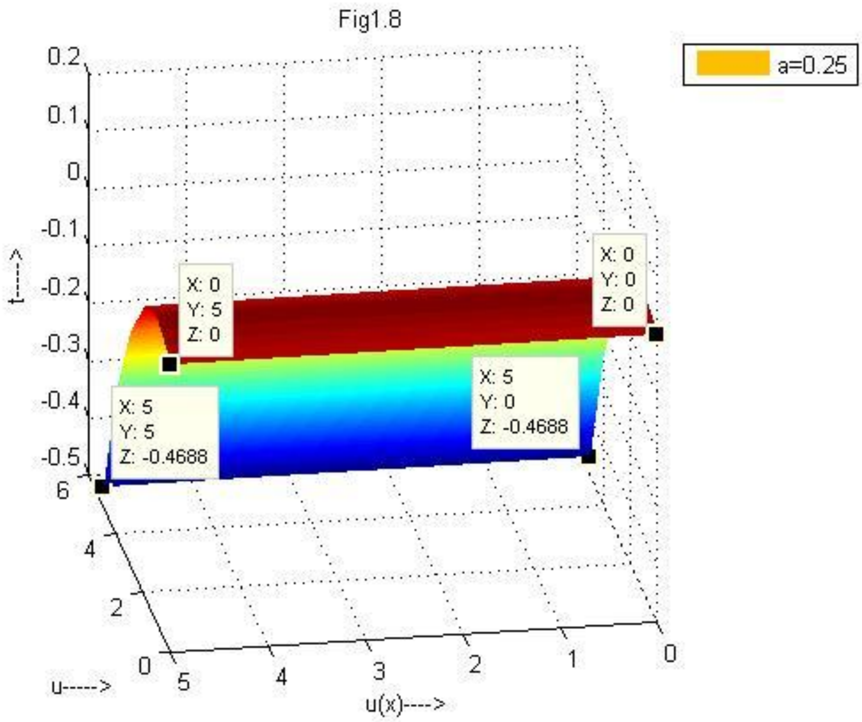

Fig1.8 The normalized numerical simulation of three-dimensional concentration u(x,t) is plotted. The plot was constructed using equation 1.12 for a=0.25

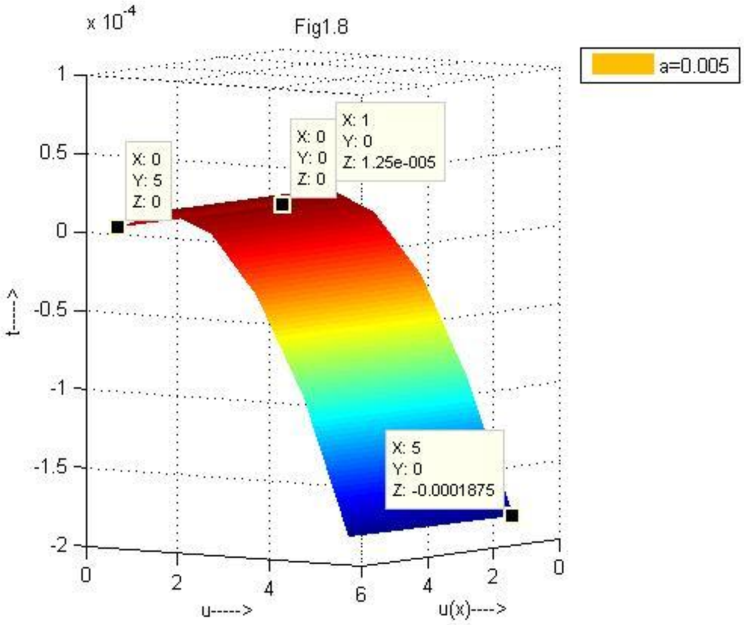

Fig1.9 The normalized numerical simulation of three-dimensional concentration u(x,t) is plotted. The plot was constructed using equation 1.12 for a=0.005

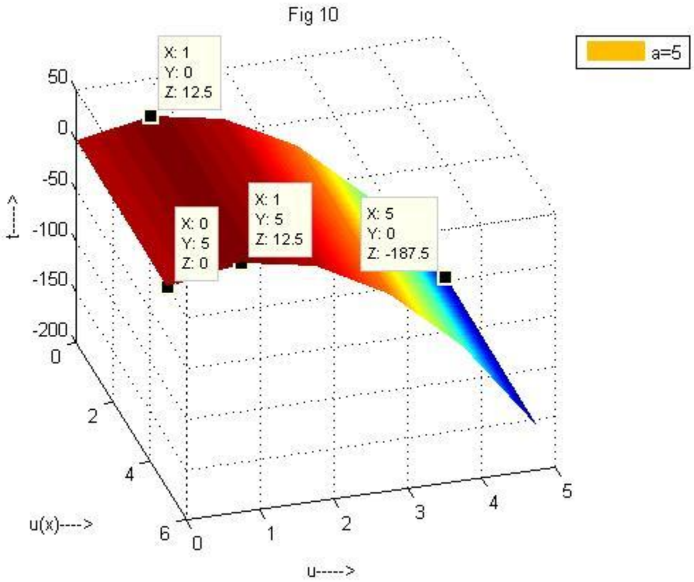

Fig 1.10 The normalized numerical simulation of three-dimensional concentration u(x,t) is plotted. The plot was constructed using equation 1.12 for a=5

Appendix

In this appendix, we indicate how equation (1.12) in this paper is derived. To find the solution of equation (1.10) we first construct a homotopy as follows:

$$(1-p)\frac{d^2u}{dx^2} + p\frac{d^2u}{dx^2} + pu^2 = 0 \tag{A1}$$

The boundary conditions are as follows

$$u(0) = a, u'(1) = 0 \tag{A2}$$

The approximate solution of (A1) is given by

$$u = u_0 + pu_1 + p^2u_2 + \cdots \tag{A3}$$

Substituting equation (A3) into (A1) and comparing the coefficients of like power of p,we obtain the following differential equations

$p^0: \frac{d^2u_0}{dx^2} = 0$ (A4)

$p^1: \frac{d^2u_1}{dx^2} + u^2{}_0 = 0$ (A5)

$p^2: \frac{d^2u_2}{dx^2} + 2u_0u_1 = 0$ (A6)

Upon solving the equations (A4) to (A6) and using the boundary conditions, we get

$u_0 = a$ (A7)

$u_1 = -\frac{a^2x^2}{2} + a^2x$ (A8)

$u_2 = \frac{a^3x^4}{2} - a^3x^3 + a^3x$ (A9)

Hence we obtain the solution,

$u = u_0 + u_1 + u_2$ (A10)

Substituting the equation (A7) to (A9) in the above equation, we obtain the equation (1.12) in the text

APPENDIX:

Function pdex4 Matlab Program to Find the Numerical Solution of Non-linear Equations

```
x=linspace(0,5);
t=linespace(0,5);
sol=pdepe(m,@pdex4pde,Apdex4ic,pdex4bc,x,t);
u1=sol(:,:,1);
figure
plot(x,u1(end,:))
surf(x,t,u1)
xlabel('Distance x')
ylabel('Time t)
title ('u1(x,t)')
```

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