Solving mechanical problem using numerical integration on

Solving Mechanical Problem UsingNumerical Integration on Speed of Car: Simpon’s 1/3Rule MethodFauzanFauzi Bin Mohamad Nora’eni (AD150132) fauBin Kushairi, (AD150076)Taufiq Bin Rohaizad (AD150185)Haziq bin Hanis Muzafery (AD150146)

comUniversiti Tun Hussein OnnMalaysia, Batu Pahat, JohorAbstract: Thefield of engineering study in solid mechanics of a rigid body which appliedforce are frequently known as force associated with these motion calledkinematics motion. Themain point is on defining quantities like position, velocity, and acceleration. It need to identify a reference frame and a coordinate system in it to get thevector expression. The aim of this project is to relate the concept used inDynamics analysis using the mathematical analysis. Mathematical analysis usedin Chapter 6: Numerical Integration by usingSimpson’s 1/3 Rule. The results of the project show that the SolidMechanics 1 analysis is related with the mathematical analysis that have beenused.

The conclusion can be drawn that the relative error between these twomethods were also had been calculated. Thus, it can determine which method wasaccurate and precise1. 0 INTRODUCTION1. 1OBJECTIVESTheaim of this project is to: 1. To Determine the distance travelled by theparticle by using the actual method and computational method.

2. Toinvestigate the distance travelled by using the mathematical method which isSimpson’s Rule. 3. Understandingthe concept of Numerical Integration and their application in mechanicalproblems. 1. 2 BACKGROUND OF STUDYA study field of the solid mechanics with thestate of rest or motion

of bodies subjected to the action of forces is calledmechanics. Engineering mechanics have two areas of study, where first is staticsand next is dynamics.

Statics is related with the equilibrium of a body that iseither at rest or moves with constant velocity. Here we will consider dynamics, which negotiated with the accelerated motion of a body. The subject of dynamicswill be presented in two parts: kinematics, which treats only the geometricaspects of the motion, and kinematics.

Integration is the process of calculating thearea under a certain function plotted on a graph. Among the most commonexamples are finding the velocity of a body from an acceleration function, anddisplacement of a body from a velocity function. There are too many complexproblem and difficult equation in engineering study. For this reason, a varietyof numerical methods has been developed to simplify the integral.

Here, wewill discuss the Simpson’s 1/3 rule of approximating integrals of the form, , where f(x)is the integrand, a is the lowerlimit of the integration and b is theupper limit of the integration. The trapezoidal rule was based on approximatingthe integrand by a first order polynomial, and then integrating the polynomialover interval of integration. Simpson’s1/3 rule is an extension of Trapezoidal rule where a second orderpolynomial approximates the integrand. 1.

3 METHODS OF INVESTIGATIONThe objective of this project is tointroduce and develop computational skills to student doing mathematicalcalculation with calculating manual or using calculator. It also expose studentan easily

computed method for solving 1/3 Simpson Method based on models usingMicrosoft Excel spreadsheet. The approach comprises entering the key parametervalues into the spreadsheet and leading the model by answering a set ofequations based on these parameter values. For an example, in this project weused distance travel by a particle moves along a horizontal path with a givenequation of velocity. So in this project we docalculations based on the Simpson 1/3 mathematics that we learn before this inEngineering Mathematic 4 and used to find the value of numerical integralequation.

The methodology in this present study should help student to createsimple simulations in excel without they need to learn a programming languageor purchase expensive software. Computational MethodThe computational method was used toconduct the simulation involved writing out the equations of velocity that wasgiven in the equation, keying the parameter values and equations into thespreadsheet and leading the model by solving the equations. The purpose in modelling thevelocity is to use experimentally obtained data to produce an accurate model ofa system. Besides, we use excel to make sure that our calculation are accurateand it make us easy to know the correct graph. Excel has a beneficial featurewhere in cell formulas are colour coded such as each of the cell denoted to ina formula is emphasized with same colour as expression in the formula makingidentification of cells referred to within formula easy.

Calculation MethodFor calculation method in this projectwe use Simpson 1/3 rule is to develop appropriate formulas for approximatingthe integral of the form

(1) Most of the formulasgiven for integration are based on a simple idea of

approximating a givenfunction bya simpler function (usually a polynomial function), where represents the order of the polynomialfunction. Simpsons 1/3 rule for integration was derived by approximating theintegrand witha 2nd order (quadratic) polynomial function. For this method, the number ofdivision or segments for N must be multiplication of 2. This is an example for ourcalculation method which is Simpson 1/3 rule: 0 1 0. 7071 1 1.

25 0. 8333 2 1. 5 0. 9487 3 1. 75 1. 0553 4 2 1. 1547 5 2.

25 1. 2481 6 2. 5 1. 3363 7 2. 75 1.

4201 8 3 1. 5000 9 3. 25 1. 5765 10 3. 5 1.

6499 11 3. 75 1. 7206 12 4 1.

7889 Afterthat, substitute this result to equation formThefinal result: = 2. 0 RESULTKinematics of particleA car is movingalong a straight road for a short time. Its velocity is defined by, v = (3-5t)m/s, where t is in seconds.

Determine the distance travelled by the car from 1sto 13s. Solution: Step 1: Write theequation of the problem which is (3- 5t). Step 2: Write theformula of Simpson’s 1/3 Rule. Where h = 1 Calculate manually, n = 13N = n – 1 = 12h = = = 1Table of result 1: Calculate manually. t y(t) = 3- 5t 1 -2 2 2 3 12 4 28 5 50 6 78 7 112 8 152 9 198 10 250 11 308 12 372 13 442 ? 440 882 680 = (1) (440 + 4(882) +2(680)= 1776a. Calculation of Simpson’s ? ruleStep 1: in cell C4, type = t for the value of time that used and drag the pointer until 13.

Step 2: in cell D4, type = y(t) for the equation. Step 3: in cell D5, type = "= 3*C5^2-5*C5″Step 4: in cell E4, type = multiplierStep 5: in cell E5, type = 1, in cell E6, type = 4 and in cell E7 type = 2. These value act asmultiplier. Step 6: in cell F4, type = product of the sum and in cell F5, type = "= D5*E5". Step 7: in cell F19, type = "=(1/3)*SUM(F5: F17)*1". This is the equation for Simpson's ? rule.

Table of result 2: Calculation of Simpson's ? rule. Graph 1: Calculation of Simpson's ? rule. Calculation by integrate of the function fromgraphStep 1: in cell B3, type = t and in cell B4, type = 1 and drag until 13.

Step 2: in cell C3, type = the function and in cell C4 =" = B4^3-2. 5*(B4^2)". Step 3: in cell C18, type = total value of the equation and in cell D18, type = "= C16-C4". Table of result 3: Calculation by integrate of the function from the graph. Graph 2: Calculation by integrate of the function from the graph. Calculation of errorStep 1: in cell B2, type = t, while in cell B3, type = 1 and drag until 13. Step 2: in cell C2, type = velocity, v (exact)Step 3: in cell D2, type = velocity, v (approximate).

Step 4: in cell E2, type = error and in cell E3, type = "= ABS ((C3-D3)/C3)" Step 5: in cell D19, type = "= (C16-D16)/C16". Table of result 4: Calculation of error b. Another way to calculate the Simpson's ? rule using excelStep 1: in cell B4, type = h and in cell C4, type = 1.

Step 2: in cell C6, type = t and in cell C7, type = 1 and drag until 13. Step 3: in cell D6, type = Then, in cell D7 type = "= 3*(C7^2)-5*C7" anddrag until 13. Step 4: in cell E6, type = Simpson's and in cell E9 type = "= (C4/3)*(D7+4*D8+D9)" and drag until13. Table of result 5: Another way to

calculate the Simpson’s ? ruleusing excel 3. 0 DISCUSSIONFor this mathematics engineering 4group project, we has choose the problem which is a moving object where the subtopic iskinematics of a particle. The main purpose of this project problem is to find outthe distance travel from 1 to 13 seconds by using. For the solution weuse chapter 6 in our syllables which is Numerical Integration by usingSimpson’s 1/3 rules.

The calculation is easy to find and can get it accuratelyby using Excel spreadsheet. In Excel spreadsheet, we apply relative row, relative column, and fixed column concepts to solve. We just type the value ofh which is 1 and then we list the value of t from 1 until13 which is to put inthe equation of y(t).

For y(t), we just have to type an equation of it andExcel will give the value of y(t). Based on the final report, the actual resultand theoretical for the equation is 1776. So, the error between the actualresult and theoretical is 0 due to the same answer. 4.

0 CONCLUSIONForthe conclusion, the result showed fromSimpsons Rule was always accurate. We see thatsome of the situations were hardly to know the function governing somephenomenon exactly and it is still possible to derive a reasonable estimate forthe integral of the function based on data points. The idea is to choose amodel function going through the data points and integrate the model function. We also seen that thereare many theoretical factors that affect the numerical integration works suchas the number of data point located is affect the result. Simpsons way more accuratecompared to the other methods such as trapezoidal method and

rectangularmethod. In this group projectassignment, the value of N that we used which is 13 and that makes the value of .

The increment is 1 starting from 1 untilreading 13. From the result, we clearly see that it is accurate. The final readingis 1776 which it can be take out from calculation. Besides that, we havecompared our calculation result with excel spreadsheet and the excel give thevalue also 1776 which is 100% accurate and same. We inserted a graph for thetheoretical calculation and actual calculation to show the related betweencalculate manually and by computerisation method.

Theexcel method proved that it is the fast and accurate way compared to manualcalculation. For an example, by simply entering the value in the Row below it cancalculate the increment in the fast and accurate way which is simple procedure. Once we put in the precise formula into the spreadsheet, an Autofill which isthe process of copying will ensure that the value in-cell formula is correctand error free. 5. 0 REFERRENCE1. Retrievedfrom http://www2.

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