Fermi National Accelerator Laboratory

FERMILAB-Conf-96/355

BPERM Version 3.0 —A 2-D Wakepotential/Impedance Code

Therese Barts

SSC Laboratory
2275 Highway 77 N.
Waxahachie, Texas 75165

Weiren Chou

Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

October 1996

Presented at *1996 Computational Accelerator Physics Conference (CAP '96)*, Williamsburg, Virginia, September 24-27, 1996.

Disclaimer

Distribution

BPERM Version 3.0
— A 2D Wakepotential/Impedance Code

Therese Barts* and Weiren Chou†

*SSC Laboratory, 2275 Highway 77 N., Waxahachie, TX 75165
†Fermilab, P.O. Box 500, Batavia, IL 60510

Abstract. BPERM 3.0 is an improved version of a previous release (1). The main purpose of this version is to make it more user friendly. Following a simple 1-2-3 procedure, one obtains both text and graphical output of the wakepotential and impedance for a given geometry. The calculation is based on a boundary perturbation method (2-5), which is significantly faster than numerical simulations. It is accurate when the discontinuities are small. In particular, it works well for tapered structures.

INTRODUCTION

The program **bperm** is a 2-dimensional code and can be employed for periodic structures with rotational symmetry. The input is one complete period of the structure described in the **r** (radial) and **z** (longitudinal) plane as an array of points. The output is the wakepotential and impedance associated with a traversing Gaussian bunch. This code and its user's guide was released in June, 1994 (1). Since then, we have received a number of comments from the users. The current version 3.0 is aimed at accomodating these comments and being more user friendly.

In this version, the input file format remains unchanged. The intermediate output can be ignored by the user. The final output contains two files: One is an ASCII file for text output, another is a postscript file for plots. The code is written in Fortran 77. It runs on Unix systems as well as on VAX/VMS. The source code, executable and examples are free to the public. The graphics interface is GNUPLOT, which is also a free software.

This paper briefly discusses some basic features of **bperm** and the execution procedure, using Unix systems as an example. For more detailed information about this code, the reader is referred to Ref. 1.

INPUT FILES

The input file must be named **bperm.in**. The following is an example:

```
dataset=test
title=bperm Test Problem
sigma=0.5
```

```
pmax=128
smax=100
shape
1.6 0.0
2.0 0.4
2.0 4.0
1.6 4.4
1.6 8.0
end
```

The meanings of the keywords are as follows: **dataset** and **title** define the name of the output files and the title on the plots, respectively; **sigma** is the rms length of a Gaussian bunch in centimeters (cm); **pmax** is the number of interpolated coordinates used for the structure; **smax** is the region of the wakepotential calculation in units of **sigma**; and the pair of numbers between **shape** and **end** are the (**r**,**z**) coordinates in cm describing the structure (similar to the way in TBCI, ABCI and URMEL). Only **shape**, **end** and the coordinates in between are required; all other keywords are optional.

COMPILE, EXECUTION AND OUTPUT

The source code **bperm.f** can be compiled using any f77 compiler. The following is an example:

```
f77 -o bperm -dn -fast -03 bperm.f
```

This will generate the executable **bperm**. To use the code, follow the 1-2-3 steps:

1. Write a **bperm.in** and put it in the same folder where **bperm** is;

2. Click on the **bperm** icon to execute;
   (This will generate a number of intermediate files, which can be ignored by the user.)

3. Type **gnuplot** `filename.gp` to get the plots and a postscript file.

The intermediate files will disappear and the final output contains just two files: `filename.out` (ASCII) and `filename.ps` (postscript).

EXAMPLES

1. A tapered periodic structure:
   Figure 1 is the structure described by the above input file, and the longitudinal and transverse wakepotentials and impedance.

2. A small bump:
   The difference from the above example is the following section:

```
shape
1.6 0.0
2.0 0.4
2.0 0.8
1.6 1.2
1.6 8.0
end
```

   Figures 2 is the plots of the structure, wakes and impedance.

3. A small iris:
   The **shape/end** section is as follows:

```
shape
1.6 0.0
2.0 0.4
2.0 7.2
1.6 7.6
1.6 8.0
end
```

   Figures 3 is the plots of the structure, wakes and impedance.

A useful feature of **bperm** is that the three input files can be concatenated into one (simply by putting the three **shape/end** sections in sequence) and all the results can be obtained from one run.

Interesting applications of **bperm** include: (i) The study of the different behaviors of impedance in high frequency regions for a periodic structure and for a single discontinuity. (ii) The study of the similar behaviors of impedance for a bump and for an iris. Results of these studies will be published elsewhere.

REFERENCES

1. T. Barts and W. Chou, *A User's Guide for the Computer Code BPERM — A Boundary Perturbation Method for Wakepotential and Impedance Calculations,* SSCL-MAN-0035, SSC Laboratory (1994).
2. Z. H. Zhang, Acta Physica Sinica, V 28, p. 563 (1979).
3. M. Chatard-Moulin and A. Papiernik, Proc. Particle Accelerator Conference, San Francisco, 1979, IEEE Trans Nucl. Sci. V 26, p. 3523 (1979).
4. R. K. Cooper, S. Krinsky and P. L. Morton, Particle Accelerators, V 12, p. 1 (1982).
5. W. Chou, Argonne National Laboratory, Light Source Note LS-149 (1990).

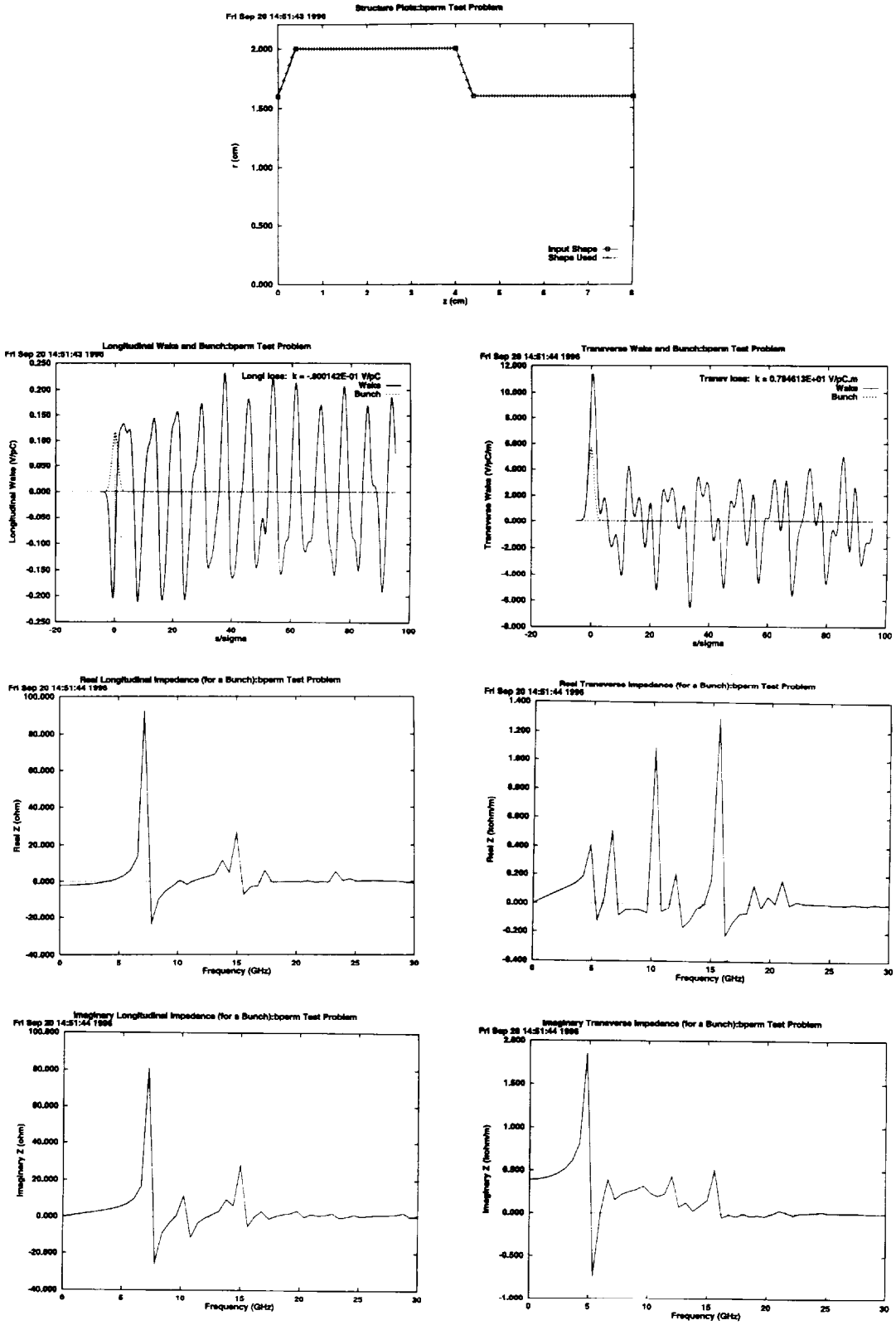

Figure 1. BPERM plots for Example 1: structure, longitudinal and transverse wakepotentials, and impedance.

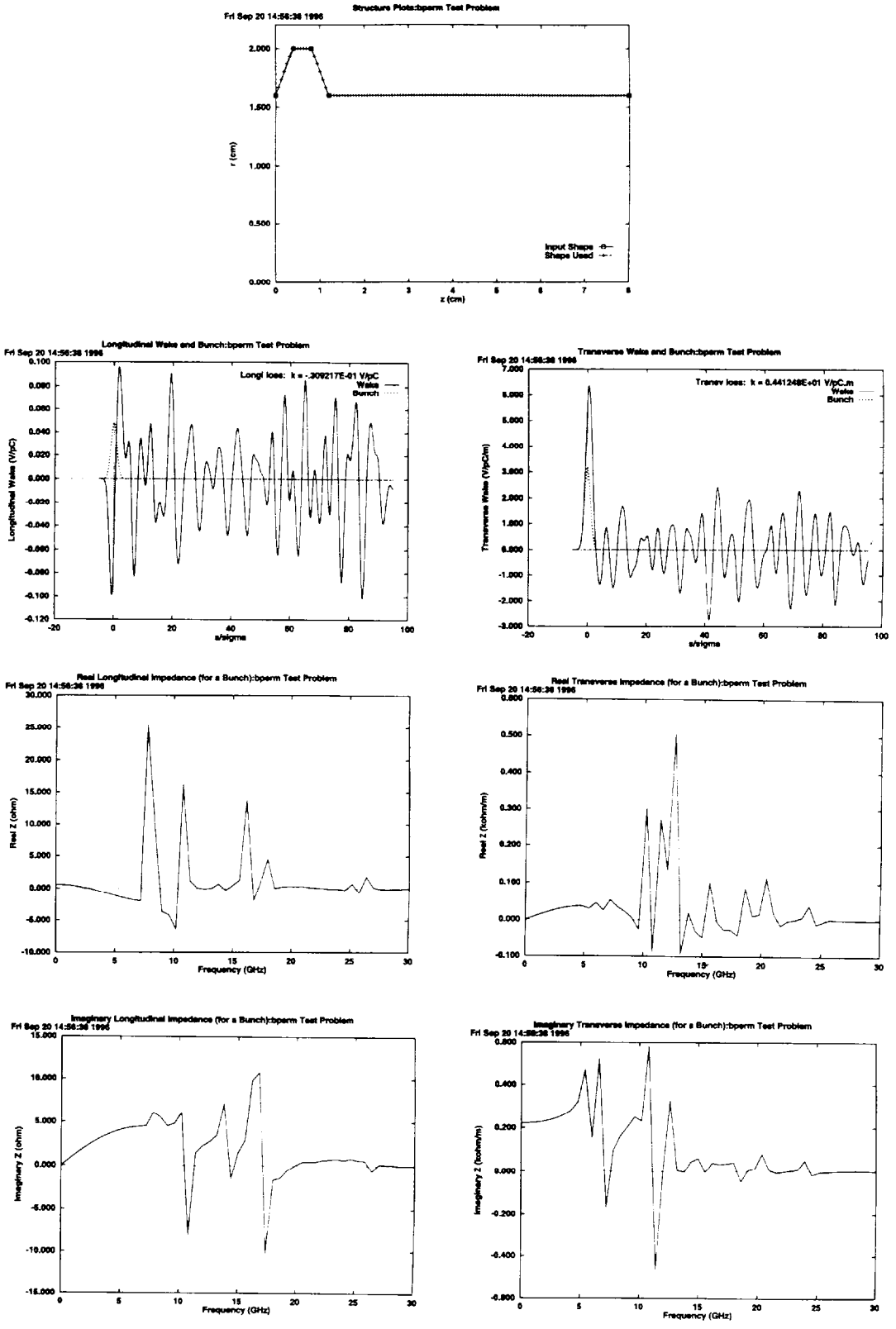

Figure 2. BPERM plots for Example 2: structure, longitudinal and transverse wakepotentials, and impedance.

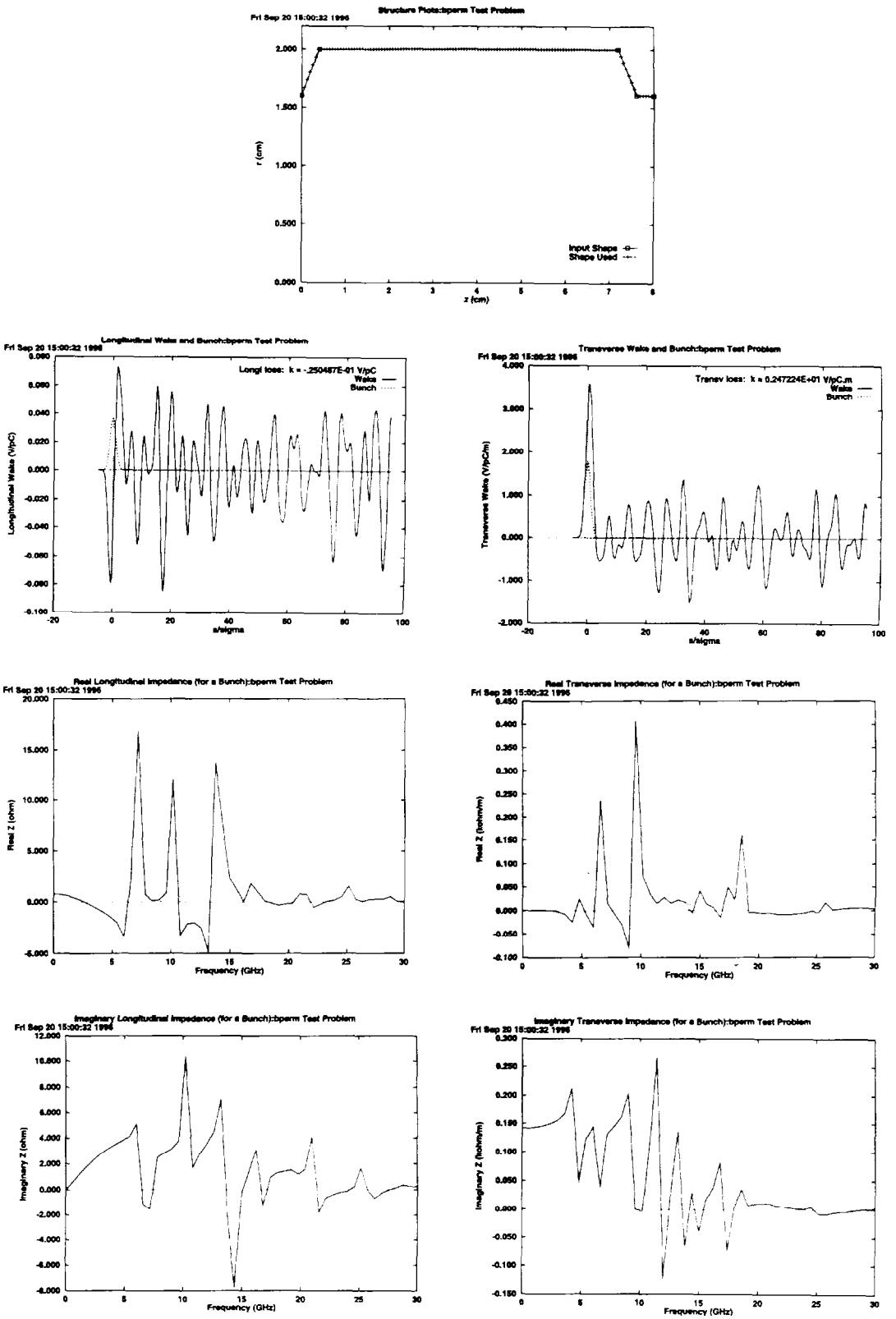

Figure 3. BPERM plots for Example 3: structure, longitudinal and transverse wakepotentials, and impedance.