1. Introduction

We will consider numerical simulation of jet noise using computational aeroacoustic methods. It is known that supersonic jet noise consists of three principal components[1]. They are the turbulent mixing noise, the broadband shock associated noise and the screech tones. Because of time limitation, we will only discuss the numerical simulation of the generation of axisymmetric mode jet screech tones. Screech tones are discrete frequency sound. At low supersonic Mach number, the screech tones are associated with the axisymmetric oscillations of the jet and radiate principally in the upstream direction. It has been known since the early work of Powell[2] that screech tones are generated by a feedback loop. Recent works[1] show that the feedback loop is driven by the instability waves of the jet flow. In the plume of an imperfectly expanded jet is a quasi-periodic shock cell structure. Figure 1 shows schematically the feedback loop. Near the nozzle lip where the jet mixing layer is thin and most receptive to external excitation, acoustic disturbances impinging on this area excite the instability waves. The excited instability waves, extracting energy from the mean flow, grow rapidly as they propagate downstream. After propagating a distance of four to five shock cells, the instability wave having acquired a large enough amplitude interacts with the quasi-periodic shock cells in the jet plume. The unsteady interaction generates acoustic radiation, part of which propagates upstream outside the jet. Upon reaching the nozzle lip region, they excite the mixing layer of the jet. This leads to the generation of new instability waves. In this way, the feedback loop is closed.

At the present time, there are reliable screech tone frequency prediction formulas[1,3]. However, there is no known way to predict tone intensity and directivity; even if it is entirely empirical. This is not surprising for the tone intensity is determined by the non-linearities of the feedback loop.

Numerical simulation of jet noise generation is not a straightforward undertaking. Tam[4] had earlier discussed some of the major computational difficulties anticipated in such an effort. First of all, the problem is characterized by very disparate length scales. For instance, the acoustic wavelength of the screech tone is over 20 times larger than the initial thickness of the jet mixing layer that supports the instability waves. Further, there