Title: The Persian musical system and the dastgàh recognition

Peyman Heydarian, London Metropolitan University

Outline of the tutorial

A tutorial on Persian music analysis, covering the intervals; the *dastgàh* (the underlying system of Persian music); forms and composition; and the MIR methods for Persian dastgàh recognition.

The dastgàh, the underlying modal system of Iranian classical music, is a phenomenon similar to maqàm in Turkish and Arabic music. It usually represents the scale and tonic, and is to some extent an indication of the mood of a piece. Methods for computational identification of the tonic and scale in Persian audio musical signals will be presented. The feature sets, chroma (a simplified spectrum) and pitch histograms; the classifiers, Manhattan distance, dot-product, and bit-mask; and theoretical and data-driven templates will be presented and compared. Theoretical templates are constructed, either using the scale intervals or by making a note histogram of existing pieces. Data-driven templates are made by calculation of the chroma of available audio samples.

1.1 Persian Intervals

There are different views on Persian intervals [1, 2, 3]. Vaziri suggested a 24-tone equal temperament (24-TET), by analogy with the Western 12-TET scale. He defined *sori* (𝄲) and *koron* (𝄳) symbols to show half-sharp and half-flat quartertones, which are widely used in Iranian music [1]. However, in musical practice the quartertones are not fixed and, depending on the scale, the piece, or the performer's mood, they can be less or more than an equal quartertone. Farhat [2] suggests that in addition to the Western semitone scale, two intervals between a semitone and a whole (small and large variants of the three-quartertone), and an interval between a whole tone and a minor third (approximating to one and a quarter tones) should be recognised.

From a signal processing point of view, all we need to know that is that in addition to Western intervals, there are flexible quartertones in Persian music, which lay between two neighbouring notes a semitone apart, and that only a few of them are used in practice. The Persian repertoire can be played with 13 different notes: 7 diatonic notes, 3 semitones and 3 quartertones [2, 3]:

E F 𝄲F #F G #G A 𝄳B B C 𝄲C #C D

1.2 *Dastgàh*

Persian music is based on a modal system consisting of seven main modes and their five derivatives: *shur*, *abu'atà*, *bayàt-é tork*, *afshàri*, *dashti*; *homàyun*, *bayàt-é esfehàn*; *segàh*; *chàhàrgàh*; *màhur*; *ràst-panjgàh*; and *navà*. They fall into five different scale categories: *homàyun* and *bayàt-é esfehàn*, *chàhàrgàh*, *shur*, *màhur* and *segàh*. The scales are provided in [3]. Figure 1 shows the five principal scales, where 24-TET is assumed. Both fixed and moving accidentals are shown.

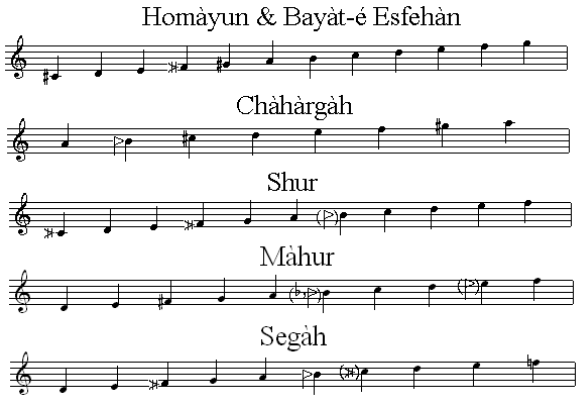

Figure 1: Scale intervals, based on 24-TET

2. DASTGAH ANALYSIS FLOWCHART

A *dastgàh* implies particular scalar intervals, a tonic, and modulations, and is to some extent an indication of the mood (emotional character) of a piece. The attributed emotions are usually culture-specific and depend on lyrics. A human listener recognises a *dastgàh* by one or more of these ways:

- Perceptually: based on the culture-specific mood of a piece
- Through melody/theme recognition: by matching the melody with known patterns
- Based on the intervals, the frequency of their occurrence, and order of the notes

The last two are clearer computationally. The bidirectional arrows between mode and melody (Figure 2) show that melody recognition reveals the mode and the mode can be used to improve melody recognition systems. A full *dastgàh* performance is recognised by tracking the modulations and the respective changing tonics.

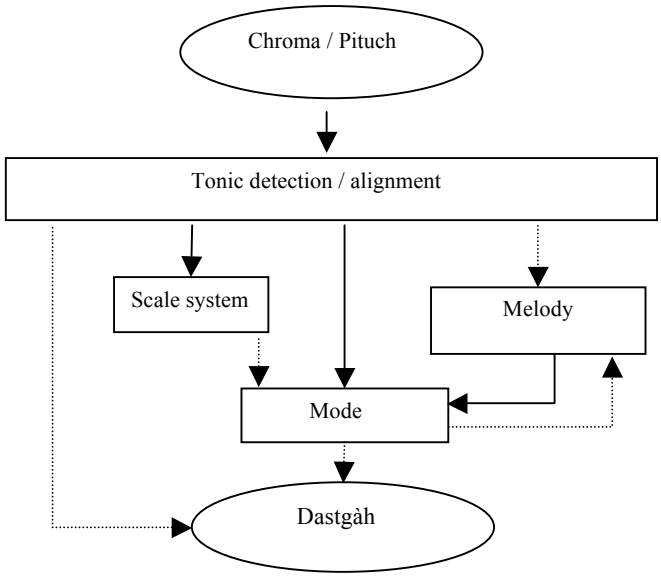

Figure 2: *Dastgàh* identification flowchart

Intended audience

Non-Western MIR researchers, ethnomusicologists, computational musicologists, Iranian and central Asian researchers

Peyman Heydarian's biography

Peyman Heydarian, born in Shiraz, Iran is an award-winning music scientist and santur virtuoso. Peyman started learning Persian music under the supervision of music masters, including Mojtaba Mirzadeh and Pashang Kamkar. His main instrument is the santur. He also plays the daf, piano, tar, violin, bouzouki, baqlama and harmonica. He has developed his own performance style on the santur and has adopted innovative tuning systems and techniques to play a multi-ethnic repertoire on the instrument.

Peyman has taught music and signal processing courses at different universities and has established and presided over a number of musical societies and bands, including the Music Association of Iranian Students (1998) and the National Iranian Students Orchestra (1999-2004). Since 1982, he has performed in Iran, USA, Canada, Syria, Jordan, Turkey, Greece, Italy, Hong Kong and the UK.

Peyman has been composing and recording music for films, including a BBC TV4 project "Axis of Light" and an Aljazeera TV film "Lover Boys". Peyman has been working in the field of music DSP since 1998. He holds BSc and MSc degrees in Electronic Engineering, from Shiraz University (1997) and Tarbiat Modarres University (2000) in Iran. And completed his MPhil on Signal processing at the Centre for Digital Music at Queen Mary, University of London (2008). Subsequently, he studied ethnomusicology at SOAS, University of London for a year (2010) and studied his PhD at London Metropolitan University (2016).