











	Turkish			Greek	Carnatic				Recall
	Aksak	Düyek	Curcuna	Cretan	Ādi	Rūpaka	M.chāpu	K.chāpu	
Aksak	21	7	2	2					66
Düyek		23	2	5					77
Curcuna	1	3	13	2				1	65
Cretan	3	5		29	3	2			69
Ādi					14	8	1	7	47
Rūpaka					3	19	1	7	63
M.chāpu					2	1	16	11	53
K.chāpu						4	1	23	82
Precision	84	61	76	76	64	56	84	47	

**Table 2:** Confusion matrix of the style classification of the large HMM (Ex-2). The rows refer to the true style and the columns to the predicted style. The empty blocks are zeros (omitted for clarity of presentation).

amount of model parameters. In the context of the HMM inference scheme applied in this paper this implies an increasingly large hidden-parameter state-space. However, we believe that this large parameter space can be handled by using more efficient inference schemes such as Monte Carlo methods.

Finally, we believe that the adaptability of a music processing system to new, unseen material is an important design aspect. Our results imply that in order to extend meter inference to new styles, at least some amount of human annotation is needed. If there exist music styles where adaptation can be achieved without human input remains an important point for future discussions.

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## 7. REFERENCES

- [1] M. Davies, N. Degara, and M. D. Plumbley. Evaluation methods for musical audio beat tracking algorithms. *Queen Mary University of London, Tech. Rep. C4DM-09-06*, 2009.
- [2] A. Holzapfel and Y. Stylianou. Beat tracking using group delay based onset detection. In *Proceedings of ISMIR - International Conference on Music Information Retrieval*, pages 653–658, 2008.
- [3] A. P. Klapuri, A. J. Eronen, and J. T. Astola. Analysis of the Meter of Acoustic Musical Signals. *IEEE Transactions on Audio, Speech, and Language Processing*, 14(1):342–355, 2006.
- [4] F. Krebs, S. Böck, and G. Widmer. Rhythmic pattern modeling for beat- and downbeat tracking in musical audio. In *Proc. of the 14th International Society for Music Information Retrieval Conference (ISMIR-2013)*, Curitiba, Brazil, nov 2013.
- [5] M. Müller, D. P. W. Ellis, A. Klapuri, G. Richard, and S. Sagayama. Introduction to the Special Issue on Music Signal Processing. *IEEE Journal of Selected Topics in Signal Processing*, 5(6):1085–1087, 2011.
- [6] G. Peeters. Template-based estimation of tempo: using unsupervised or supervised learning to create better spectral templates. In *Proc. of the 13th International Conference on Digital Audio Effects (DAFX 2010)*, Graz, Austria, 2010.
- [7] G. Peeters and H. Papadopoulos. Simultaneous beat and downbeat-tracking using a probabilistic framework: Theory and large-scale evaluation. *IEEE Transactions on Audio, Speech and Language Processing*, 19(6):1754–1769, 2011.
- [8] L. R. Rabiner. A tutorial on hidden markov models and selected applications in speech recognition. In *Proceedings of the IEEE*, pages 257–286, 1989.
- [9] A. Srinivasamurthy, A. Holzapfel, and X. Serra. In search of automatic rhythm analysis methods for Turkish and Indian art music. *Journal for New Music Research*, 43(1):94–114, 2014.
- [10] A. Srinivasamurthy and X. Serra. A supervised approach to hierarchical metrical cycle tracking from audio music recordings. In *Proc. of the 39th IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP-2014)*, pages 5237–5241, Florence, Italy, May 2014.
- [11] N. Whiteley, A. Cemgil, and S. Godsill. Bayesian modelling of temporal structure in musical audio. In *Proc. of the 7th International Conference on Music Information Retrieval (ISMIR-2006)*, Victoria, 2006.